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Central Body Electronics (ZKE III)

Initial Print Date: 12/04 Revision Date:

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Central Body Electronics (ZKE III)

Model: E38, E39 and E53

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Understand the functions and features of ZKE III
- Understand the differences in ZKE features between vehicles
- Identify and locate ZKE III system components
- Diagnose concerns on the ZKE III system

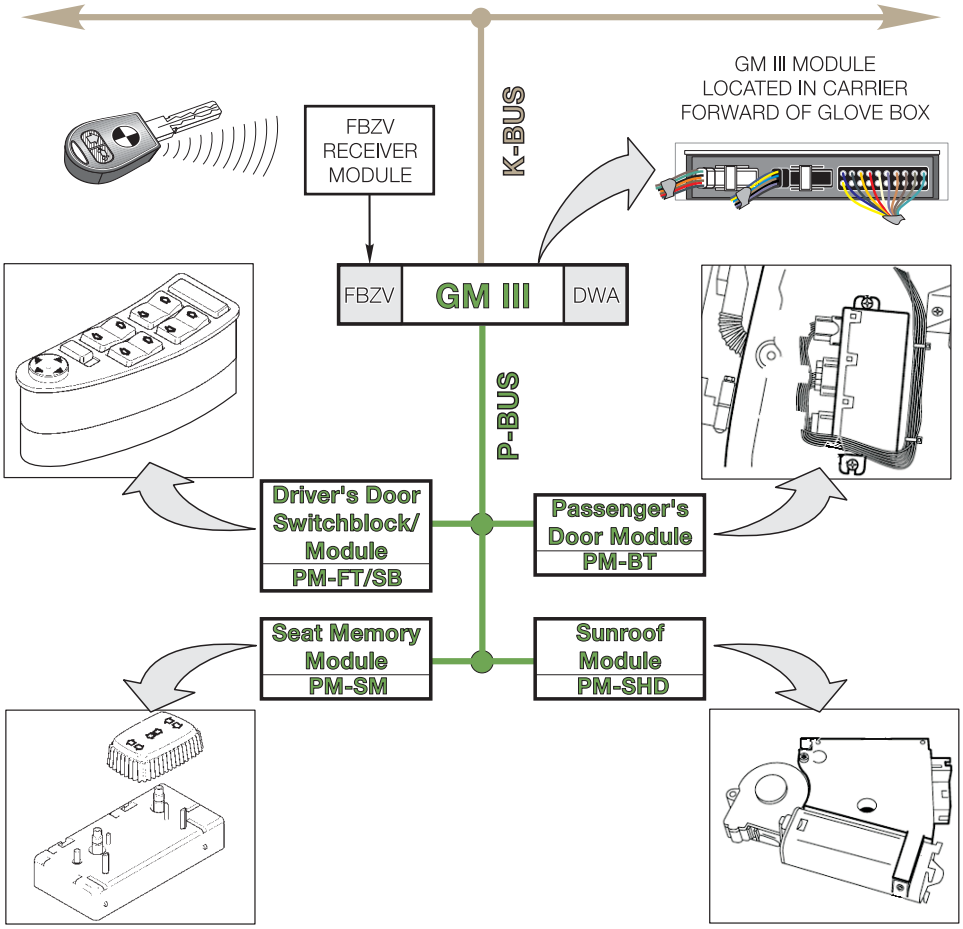
Central Body Electronics (ZKE III)

The ZKE III system was introduced on the E38 in 1995 and subsequently used on the E39 and the E53. ZKE III is responsible for the control of various body electronics systems. Although there are some functional differences from model to model, the majority of the functions and systems are identical.

The ZKE III system is comprised of the General Module (GM III) which is connected to a network of peripheral modules all connected by a bus network. The Peripheral Bus (P-Bus) is responsible for transferring commands and information between various system components.

The modules on the P-Bus which are connected to the GM include:

- Driver's side door module (switchblock) PM-FT/SB
- Passenger door module (PM-BT)
- Sunroof module (SHD)
- Seat/mirror/steering column module PM-SM



The modules of the ZKE III system are networked together by the P-Bus to control the functions of the body electronics which include:

Systems controlled directly by the GM III

- Windshield Wiping/Washing
- Automatic Interval Control (Rain Sensor)
- Headlight Washing
- Tailgate Wiping/Washing
- Interior Lighting
- Central Locking
- Keyless Entry
- Key Memory
- Power Trunk Release
- Electric Opening of Tailgate
- DWA Alarm System
- Servotronics
- Consumer Cut-off/sleep mode
- Diagnosis

Systems controlled by the Driver's Door Switch Block module

- Power Windows
- Mirror Adjustment/Memory/Heating

Systems controlled by the Passenger's Door Module

- Mirror Adjustment/Memory/Heating
- Power Windows

Systems controlled by the Sunroof Module (SHD)

- Power Sunroof

Systems controlled by the Seat/Mirror/ Steering Column Memory Module

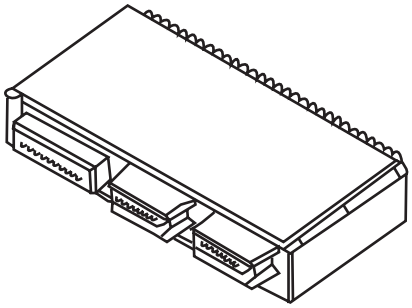
- Seat Adjustment/Memory
- Steering Column Adjustment/Memory

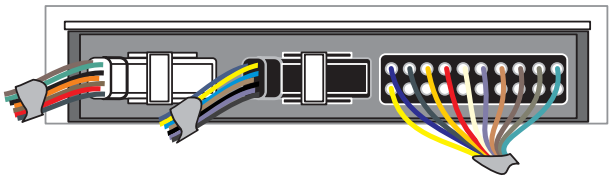
System Components

The system components listed below are the main components of the P-Bus on ZKE III. The individual system components will be discussed with each system.

General Module (GM)

The GM is responsible for the operation and central coordination of body electronics. The GM is a micro-computer that is the central component (heart) of the Central Body Electronics. The GM is located behind the glove box.





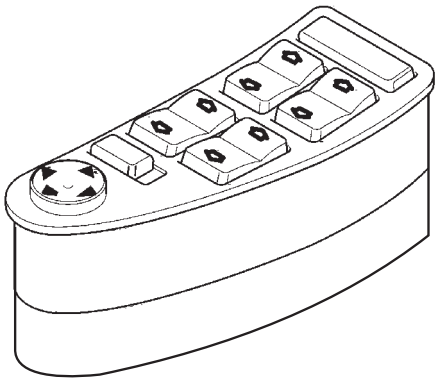
The GM communicates with other vehicle systems via the K-Bus. The GM is also the main controller (master) of the P-Bus. Other functions of the GM include the processing of inputs from sensors and switches as well as controlling various output stage transistors to operate relays and other control circuits.

Driver's Door Module and Switch Block (PM-FT/SB)

The driver's door module and switch block is connected to the P-Bus and contains the switches for all four doors, mirror switch and child lockout switch.

On the E38 models for the 95 model year, the driver's door module was a separate component from the switchblock.

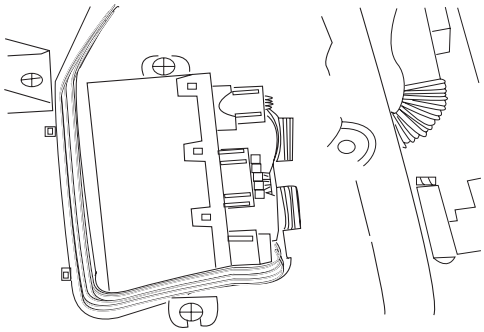
From 1996, the switchblock and the door module were integrated into one unit.



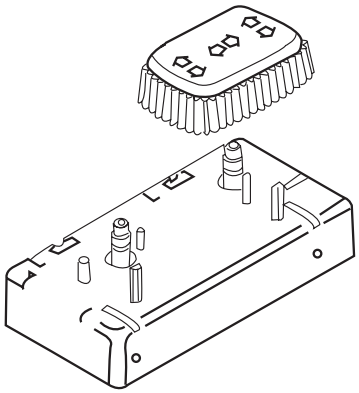
Passenger Door Module (PM-BT)

The passenger door module is also on the P-Bus and is responsible for controlling the passenger side power window, mirror motors, mirror heating and memory functions.

The passenger door module is located on the passenger side door under the door panel.



Seat Memory Module (PM-SM)

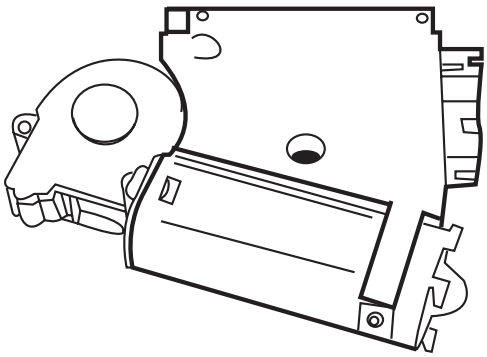


The Seat Memory module, which is located on the left side of the driver's seat, is used to control the seat, steering column and and mirror functions.

The module is also responsible for controlling the seat and steering column motors.

The seat memory module also contains the switches for seat operation and on the E53, the memory switches as well.

Sunroof Module (SHD)



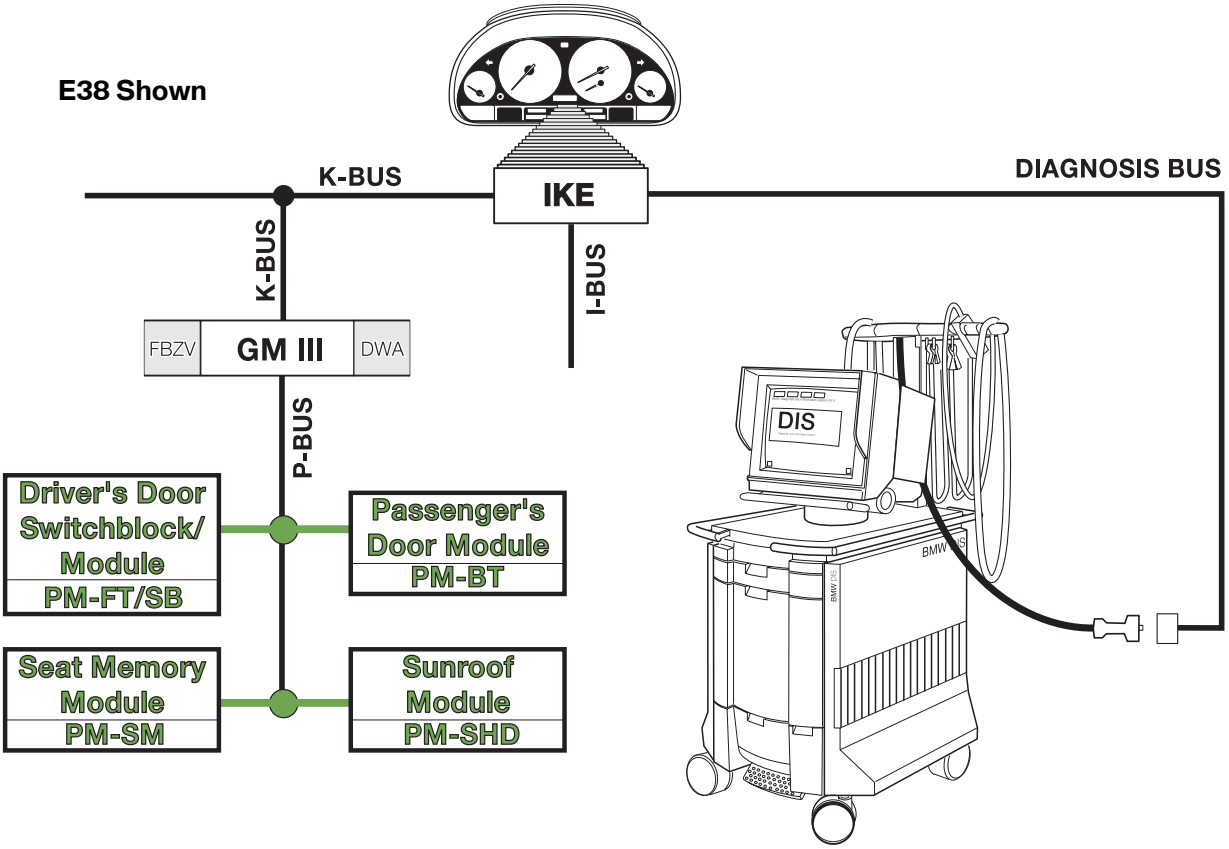
The sunroof module is located in the overhead console area behind the sunroof switch.

The SHD module controls the operation of the sunroof and is responsible for the anti-trap functions as well as the convenience open and close features.

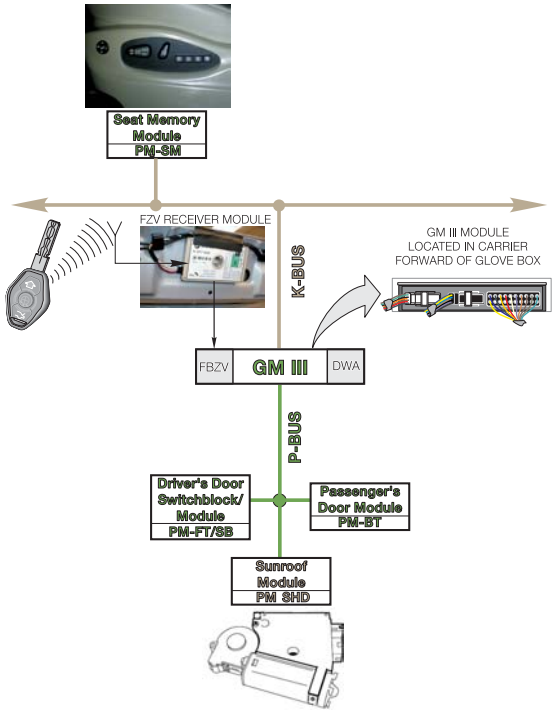
The sunroof motor is also integrated into the SHD module.

ZKE Overview

E38 Shown



E53 Shown



Windshield Wiping/Washing

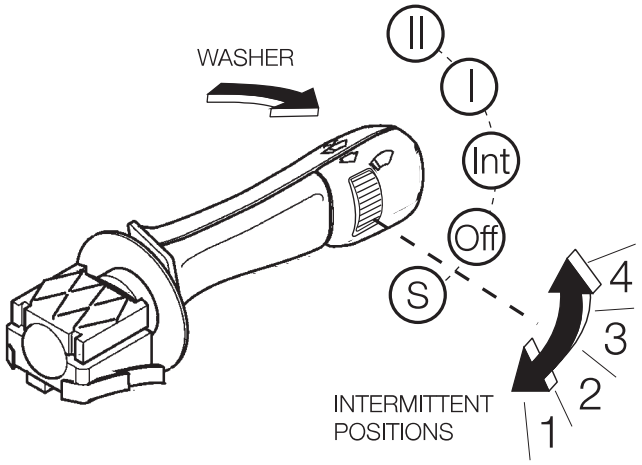
The windshield wiping/washing functions are controlled by the GM III when the ignition is in position KL R or KL15. The system has four wiping stages and four interval wiping speeds. The wiper motor output control is through two relays (double relay >98 MY, except E38) that are located in the Electronics box (E box).

The Windshield Wiping System can also be supplemented with the optional Automatic Interval Control (AIC) system. AIC uses input from a Rain Sensor (or RLS) to control the wiper intervals in the intermittent mode. The Rain Sensor detects rain drops on the windshield and sends signals to the GM via the K-Bus.

System Components

Wiper Stalk Switch Input

The wiping stage inputs are coded signals through a two wire link with a combination of high/low inputs.



The wiping stages include:

- **Single (S)** - Momentarily holding the wiper switch down in the single position provides a momentary ground signal to activate a single sweep in slow speed.
- **Slow (I) and Fast (II)** - The stage I and stage II wiping speeds are road speed dependent. Stage I switches to intermittent when the vehicle is stopped and stage II switches to stage I when stopped.
- **Windshield Washing** - The wash request provides a switched ground input to the GM by pulling the stalk rearward. The GM activates the windshield washer pump directly.
- **Intermittent (Int)** - The intermittent wiping time inputs are provided by a potentiometer mounted in the wiper stalk switch (1 through 4). The intermittent wiping intervals are also dependent on the road speed. As road speed increases, the wiping interval is shortened.

Wiper Intermittent Intervals

Thumbwheel Position	Vehicle speed in MPH					
	<4	5-22	23-45	46-60	61-87	>87
	Wiper time delay in seconds					
1	26	19	17	15	15	13
2	17	12	11	10	9	7
3	10	6	6	5	4	3
4	5	3	3	2	2	2

Headlight Washing (if equipped)

The headlight washing feature is part of the cold weather package. When the headlights are on, the headlight washer pump is activated with the first activation of the windshield washer pump. It is only activated again after five successive windshield washer cycles during the same ignition key on cycle (rest function). The GM recognizes headlights on via K-Bus signalling. The GM provides a ground on the headlight washer relay control circuit providing pump operation. The headlight washer pump is located on the side of the washer fluid reservoir.

Rear Window Wiper/Washer System (E39 Wagon and E53)

The system is included in the scope of ZKE however is not controlled directly by the GM. The control electronics are integrated into the rear wiper motor assembly. The control electronics contains two hall sensors, one for monitoring park position and other for the end stop, or to signal reverse direction of the wiper motor. The control electronics are connected to the vehicle electrical system via a single seven pin connector.

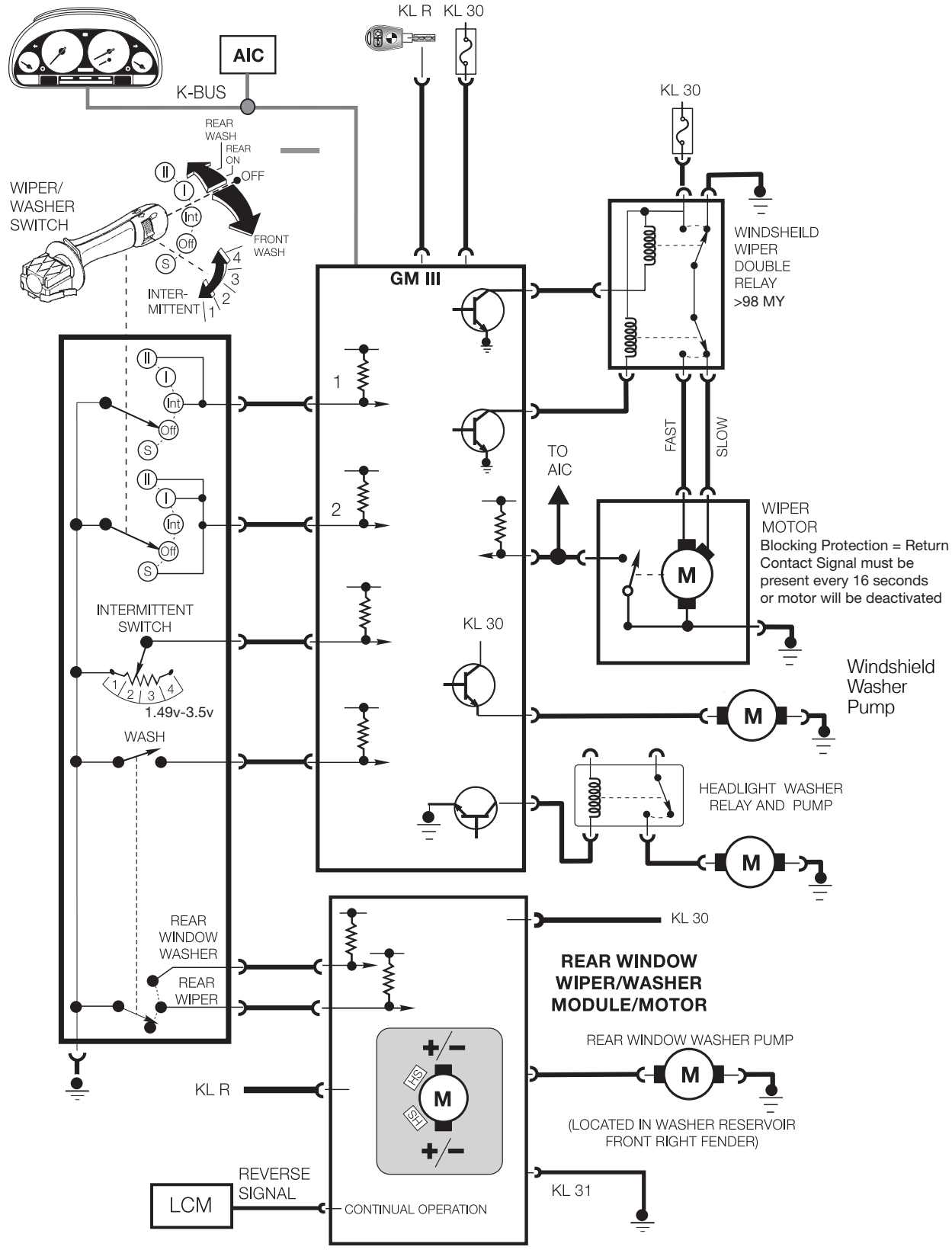
The rear wiper system is operator controlled through the wiper stalk switch providing the following functions:

- Intermittent rear window wiping
- Programmed rear window wiping interval
- Operation of the rear window washer

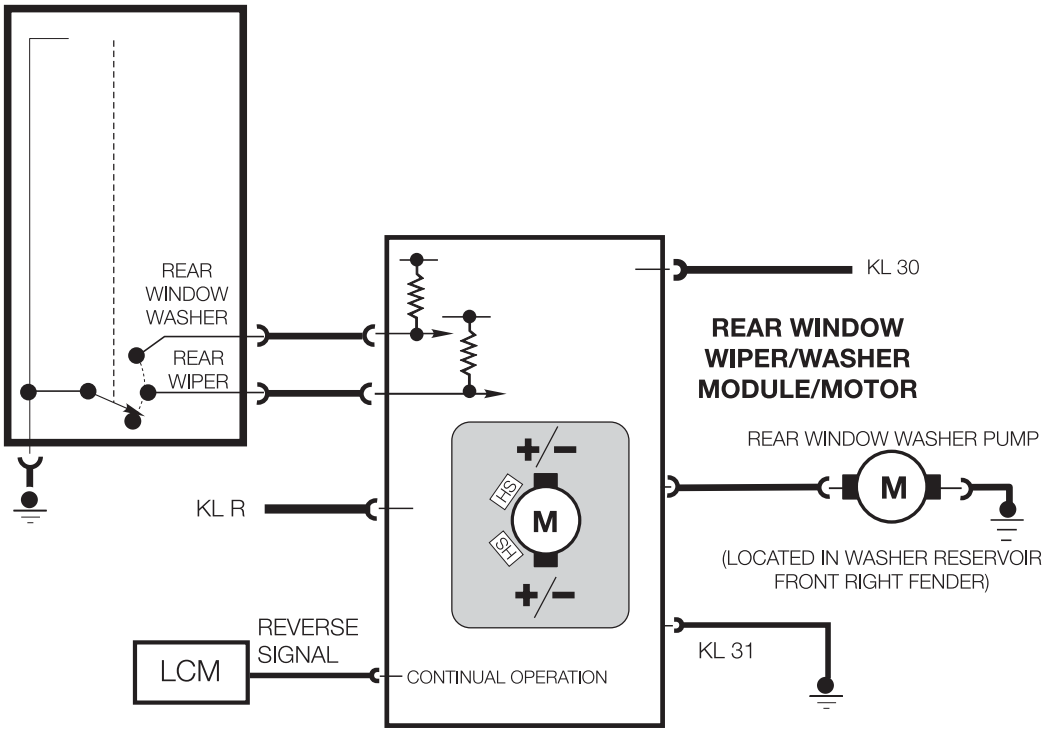
Pressing the wiper stalk forward to the first detent activates the rear wiper in the intermittent mode.

The timed interval is approximately 7-12 seconds. The full sweep and park positions are recognized by the two hall sensors on the motor gear assembly. If the wiper is switched OFF, the wiper blade will return to the park position.

Wiper System with Rear Wiper Washer (E53 Shown)



Rear Wiper System (E39 Sportwagon and E53)



The programmed wiper interval procedure is as follows:

- Briefly switch the rear wiper ON/OFF
- Wait the desired interval time
- Switch the rear wiper ON again
- The OFF time will be the programmed interval - up to approximately. 30 seconds

Rear window washing is activated by pressing the wiper stalk switch to the full forward position. The washer pump operates followed by two full wiping cycles. The wipers will then switch to the intermittent wiping mode. Additionally, the system automatically controls the following safety and convenience features:

- Wiper interrupt with the rear glass opened
- Wiping interrupt with a blocked wiper arm
- Continuous wiping when the vehicle is shifted into reverse

When the transmission is shifted into reverse, the wiper will switch to continuous operation until the vehicle is shifted out of reverse. This signal (high) is provided by the LCM III when it activates the back up lights.

Automatic Interval Control (AIC)

The Windshield Wiping System is also available with an optional Automatic Interval Control system (AIC).

The AIC system provides added driver convenience and enhances safety by controlling the wiper intermittent function automatically based on the volume of rain detected on the windshield.

The primary device which makes the AIC system possible is the new Rain Sensor.

System Components

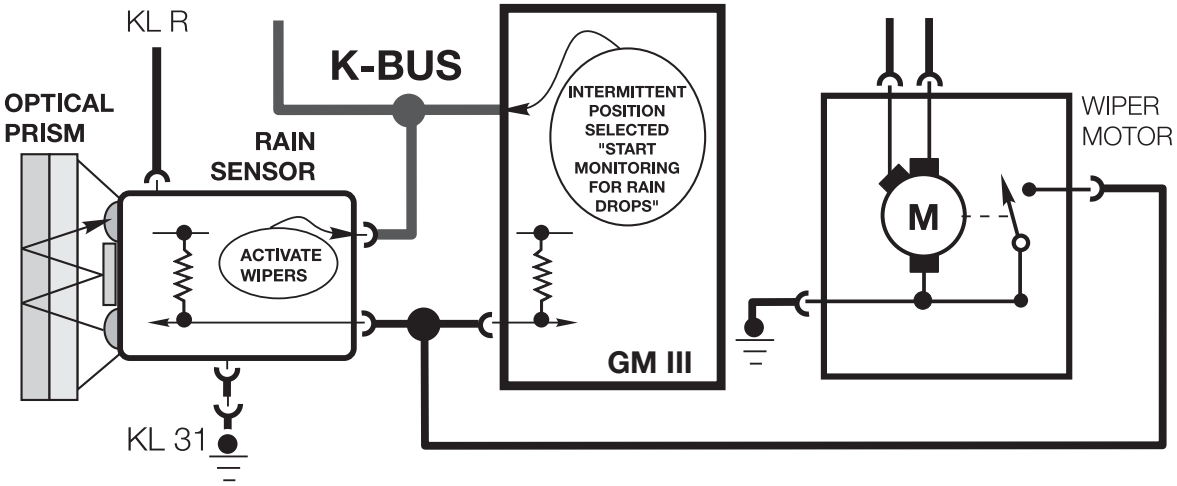
Rain Sensor

The unit is mounted on the top center area of the interior windshield surface directly behind the rear view mirror.

The unit contains:

- **Optical Prism Body** - This portion of the unit is permanently fixed to the windshield. It can not be removed and can only be replaced with a replacement windshield. The prism body has a reflective surface that faces the back of the windshield. The prism body also acts as the windshield mount for the Rain Sensor Control Module.
- **Rain Sensor Control Module** - The control module incorporates the following;
  - Infra Red Emitter and Detector Diodes
  - Optics heater (prevents condensation from forming on diodes and prism)
  - Optics evaluation and control electronics
  - Photo cell to detect night driving

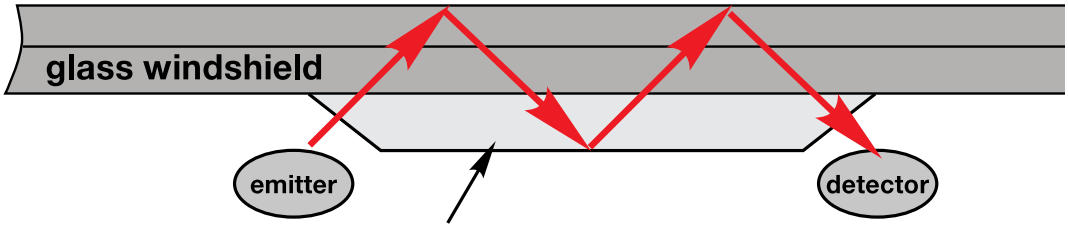
The control module requires four signals for operation; KLR, KL31, Windshield Wiper Motor Park Signal Feedback and K-Bus interface.



Principle of Operation

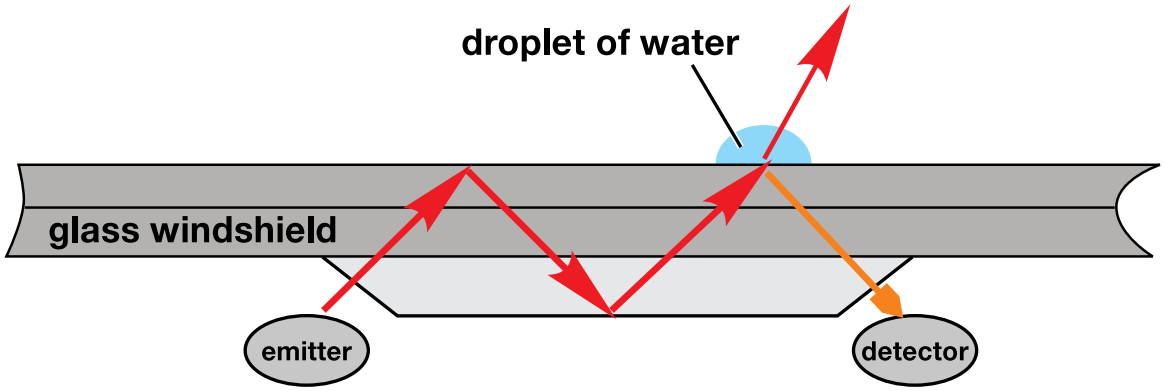
The optical infra red portion of the sensor operates by the principle of refraction (bending of a light ray). The rain sensor control module activates the emitter diode which sends a beam of infra red light through the windshield on an angle. The set angle is important because it provides the beam with a calculated reflective path back to the detector diode.

The beam is reflected back into the windshield due to the density difference of the glass compared with the ambient air on the outside surface of the glass. When the windshield is clean (no rain drops, moisture or dirt) the detector diode receives 100% of the infra red light that the was sent by the emitter. With this condition, the rain sensor evaluation electronics determines the windshield is free of rain drops.



RAIN SENSOR PRISM OPTICS

The density of water is closer to that of glass than air. When rain starts to accumulate in the sensor monitoring area, it causes part of the infra red beam to extend past the outside surface of the glass and into the rain drop. When this occurs, the beam is refracted and only part of the beam returns to the detector diode.



The rain sensor evaluation electronics determines the windshield has a few rain drops (or dirt) on it. The intensity of the returned infra red beam diminishes proportionally with an increase of water droplets. The rain sensor control module generates a signal proportionate to the amount of rain on the windshield and broadcasts it to the GM via the K bus.

The GM activates the intermittent wipe cycle if the windshield wiper stalk switch is in the intermittent position. It also adjusts the frequency of wiping the windshield depending on the four position thumb wheel.

Rain Sensor Function

The rain sensor is online as soon as it receives KLR operating power.

- When the windshield wiper stalk switch is placed in the intermittent position the GM signals the rain sensor control module via the K-Bus of the request for intermittent wiping and the position of the knurled wheel (sensitivity).
- As an acknowledgement, the rain sensor sends a command via the K Bus to activate the wiper motor. If more than 12 seconds pass before the GM receives the acknowledgement, the GM concludes the rain sensor has a defect and operates the intermittent wipe function as a system not equipped with a rain sensor. The wiper intermittent cycling is based solely on the knurled wheel setting.
- The rain sensor continuously monitors the windshield for rain accumulation and signals the GM to activate the wipers based on the knurled wheel position and how fast the rain accumulates on the windshield.
- The knurled wheel position signal (1-4) via the K bus informs the rain sensor of the selected level of sensitivity.
    - Position 1 (least sensitive) delays the wiper activation signal.
    - Position 4 (most sensitive) sends the wiper activation signal to the GM sooner.
- When the wiper motor park contacts signal the GM of the wiper arm position, the signal is simultaneously sent to the rain sensor as an indication that the windshield has been cleared of water drops and causes the rain sensor to reset the sensitivity delay timer back to 0.
- If night time driving is detected via the integral photocell, the sensitivity to water droplets is increased causing a shorter delay than day time driving.
- Depending on the intensity of the rain the wipers will be operated continuously as if set in the normal wiper stalk switch position regardless of the knurled wheel setting. For this reason, the vehicle speed signal on the K bus is not utilized on rain sensor equipped wiper systems.
- If the ignition switch is turned off with the wiper switch in the intermittent position, the rain sensor will only become active after the ignition is switched back on and one of the following occurs:
    - The stalk switch is moved from the intermittent position and then back.
    - The knurled wheel setting is adjusted.
    - The wash function is activated.

The reasoning behind this switching strategy is to have the driver make a conscious decision to activate the system themselves.

Rain Sensor Control Module Adaptation

The rain sensor control module adapts to the optics system environment as follows:

- **Windshield Aging** - As the vehicle ages the possibility of stone chipping in the rain sensors monitoring area may occur which will cause a loss of light in the optics system.

  The control module adapts for loss of light based on the intensity of the detected infra red light with a cleared windshield (wiper motor park signal). Therefore, the rain sensors function is not adversely affected due to windshield aging.

- **Dirty Windows** - The rain sensor adaptation reacts less sensitively to a dirty windshield (dirt, road salt, wax residue) after a completed wipe cycle. A dirty windshield has a film on it that diminishes the ability of the infra red to refract into present water droplets. This causes a delay in the rain sensor detection capabilities which lengthens the time intervals on an intermittent wipe.

Windshield Wiper System Failsafe Operation

The GM provides failsafe operation of the wiper system if faults are detected with any of the following input signals:

Function	Faulted Input Detected	Failsafe Function
Intermittent Wipe	Short or open circuit of the knurled wheel signal	Delay value for setting 3 used
Intermittent wipe With Rain Sensor	Faulted Rain Sensor or K-Bus Signal corrupt	Normal Intermittent wipe implemented
Wiper Motor not Functional Moving	Park contact feedback signal takes longer than 16 seconds	Wiper motor control deactivated for 3 minutes

Workshop Hints

Windshield Wiper Blade Service

To access the wiper blades for cleaning or replacement,the following is required:

- With the ignition switched on (KL15), switch the wiper stalk to the “Intermittent” wipe mode.
- Switch the ignition off when the wiper arms are in the “upright” position.

CAUTION!!! ***Do not allow the wiper arm to spring back against the windshield, glass breakage will occur!***

Rain Sensor Equipped Vehicles

Make sure the wiper blades are in perfect condition. Only use window cleaner to clean the windows. Dirty windows can cause the Rain Sensor control module to set a fault due to the end limits of its adaptation abilities.

Rear Window/Wiper

The wiper arm and driveshaft are connected by splines. Special tool #61 1 320 is required to hold the drive shaft in the park position prior to installing the wiper arm on to the drive shaft.

Windshield Wiper System Diagnosis

The GM monitors the following circuits:

- Wiper Potentiometer
- Wiper Motor
- Terminal 30
- Double Relay
- Windshield Washer Pump

Note: The wiper/washer operation will be interrupted during engine cranking. The GM provides this “unload” feature to preserve the battery voltage for the starter motor.

Workshop Exercise

Using an instructor designated vehicle, perform a complete vehicle short test. Locate the General Module and connect appropriate test cables (B.O.B.) as needed.

Using the appropriate fused jumper wire, ground the park contact signal with the wipers on and observe the effect.

What effect does the missing park signal have on wiper operation? What fault codes are stored?

Locate the wiper (double) relay and access the correct ETM for the wiper circuit.

What connector and pins control the wiper double relay?

In intermittent mode, which of the relay control circuits are active (energized)?

Disconnect the Rain Sensor and operate the wipers.

What is observed regarding the operation of the wipers with the Rain Sensor disconnected?

Workshop Exercise - Diagnosis

Using an instructor designated vehicle, diagnose the concern indicated by the instructor. Complete this worksheet using the proper "Complaint, Cause and Correction" format.

Vehicle: _____ Chassis #: _____ Production date: _____

Complaint:

Cause:

Correction:

Classroom Exercise - Review Questions

1. List the functions directly controlled by the GM III:

2. How does the GM III communicate with other control modules?

3. What effect does road speed have on the wiper system?

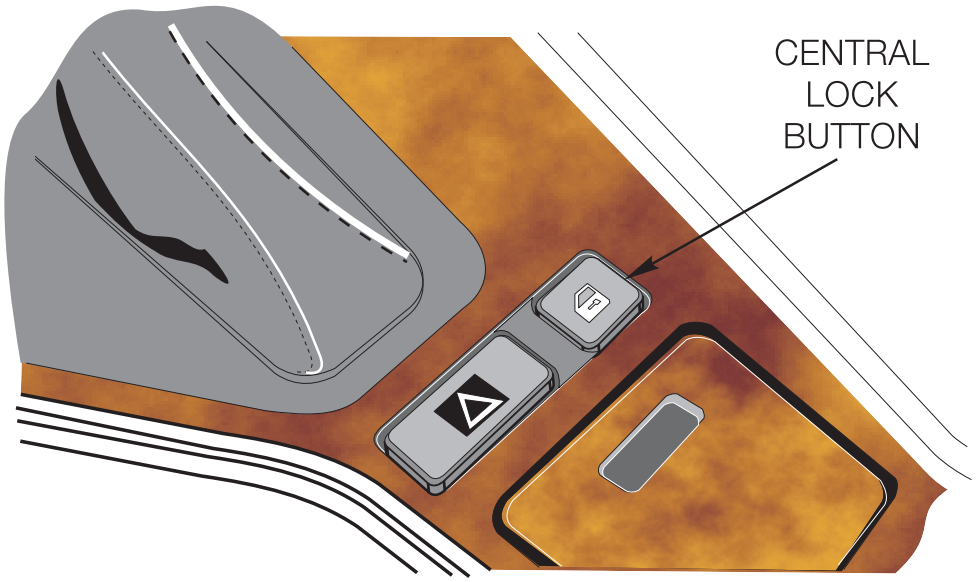
4. Why is the wiper “park signal” sent to the GM and Rain Sensor simultaneously?

5. Why is there a reverse gear input signal to the Rear Window Motor/Module on the E39 sportwagon (and E53)?

Central Locking

The Central Locking System provides locking/unlocking of the entire vehicle from one central exterior point. From the driver's door or the remote (key-less) entry, a lock/unlock request will lock/unlock all exterior doors, luggage compartment and the fuel filler flap.

From inside, the vehicle can be locked/ unlocked using a central locking button located in the center console. Individual doors can be unlocked manually by pulling twice on the interior door handle.



From the 2000 model year, if the vehicle has been double locked, press the central locking button and pull the interior door handle twice (alarm will sound when the door opens).

Locking the vehicle from the central switch will "single lock" all doors, luggage compartment and not lock the fuel filler flap.

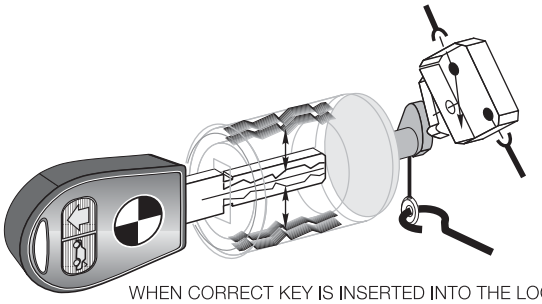
The Central Locking System utilizes the GM III and Door Modules to carry out all of the locking/unlocking features:

- Remote (key-less) entry is standard.
- When locked from the outside, the vehicle will double lock and arm the DWA System. The ignition must be switched off and the driver's door must be opened and closed.
- Selective unlocking from the outside of the vehicle. Unlocking from the driver's door or remote transmitter will only unlock the driver's door and disarm the DWA System. A second request will unlock the remaining doors and luggage compartment. This feature can be modified for individual users in Key Memory to open all doors from a single request.

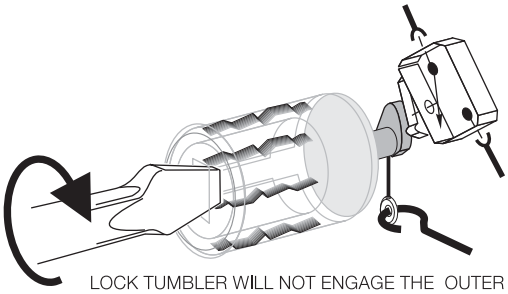
- A single central locking button is installed in the center console that will operate when all of the doors are closed. Locking the vehicle from the central switch will “single lock” all doors, luggage compartment and not lock the fuel filler flap. When unlocking, a single request will unlock the driver’s door only. This feature can be modified for individual users in Key Memory to open all doors and luggage compartment from a single request.
- A remote luggage compartment button is installed in the left kick panel (center console in the E53) to open the luggage compartment from inside the vehicle.
- The EWS is interfaced for double lock monitoring and unlock function. With the presence of an accepted EWS key in the ignition, the vehicle will be unlocked and disarm DWA.
- The automatic locking feature (> 99 MY) activates the door locks when a road speed signal of 5 MPH and engine RPM is detected via the K-Bus. The factory default setting of this feature is off (can be encoded on for individual users with Key Memory function).
- In the event of an accident (ignition on), the GM will be signalled to unlock all doors.

The following are the hardware features of the central locking system:

- The external lock cylinders are located in the driver’s door and luggage compartment lid (E53/E39 Sport Wagon does not have a tailgate lock cylinder).
- The driver’s door and luggage compartment incorporates an overrunning lock cylinder. The lock cylinder will free wheel or spin If any key other than the vehicle key or tool, such as a screw driver, is inserted into the cylinder. The lock cylinders can be manually locked/unlocked by turning the key “past” lock/unlock.



WHEN CORRECT KEY IS INSERTED INTO THE LOCK
THE TUMBLER ENGAGES WITH THE OUTER BARREL
ALLOWING PROPER LOCK OPERATION.

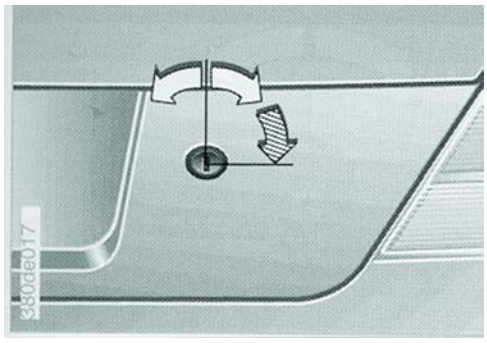


LOCK TUMBLER WILL NOT ENGAGE THE OUTER BARREL
CAUSING THE TUMBLER TO CONTINUOUSLY ROTATE.

- The door lock buttons are mechanically uncoupled from the lock actuators when locked. The door lock buttons “mechanically” lock the individual doors. This provides manual locking in the event of a central locking malfunction.

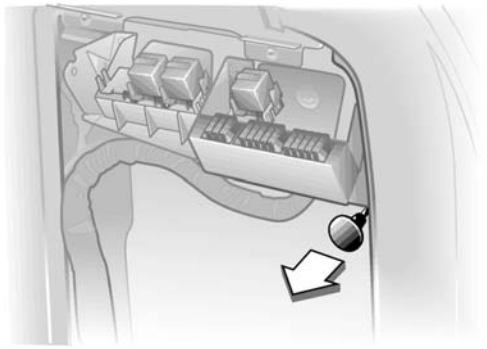
- Child safety locks (located in the rear doors) are actuated by inserting a key in the slot on the door latch or by sliding a lever (dependent on model). The door can now only be opened from outside.
- The luggage compartment can be manually locked with a “Master Key” and leaving the lock cylinder in the horizontal position which prevents opening by any other method (secured for valet).

  The luggage compartment release button inside the vehicle will also be ignored by the GM. Prior to 2000 MY the vehicle could be locked or unlocked using the luggage compartment lock cylinder.



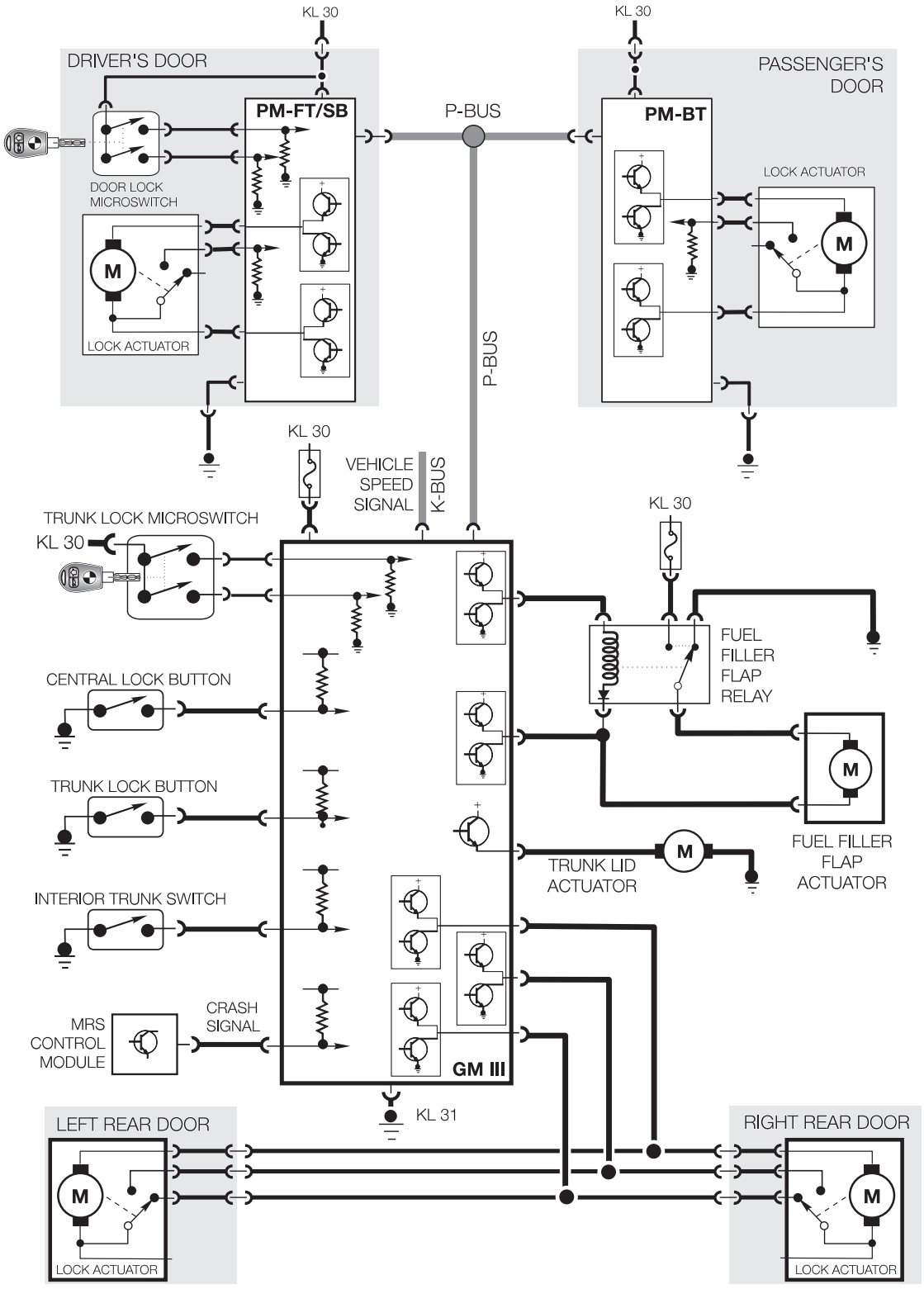
- The glove box has a lock cylinder to secure the contents by manual locking with a “Master Key” and leaving the lock cylinder in the horizontal position which prevents opening by any other method (secured for valet).
- The E38 has a lever behind the glove box handle which permits locking the glove box with out a key. Opening still requires a key. *The valet key is not mechanically capable of entering either of these lock cylinders.*

- The Fuel Filler Flap mechanical release is found in the right side of the luggage compartment. The “pull tether” is behind the button as shown on the right.

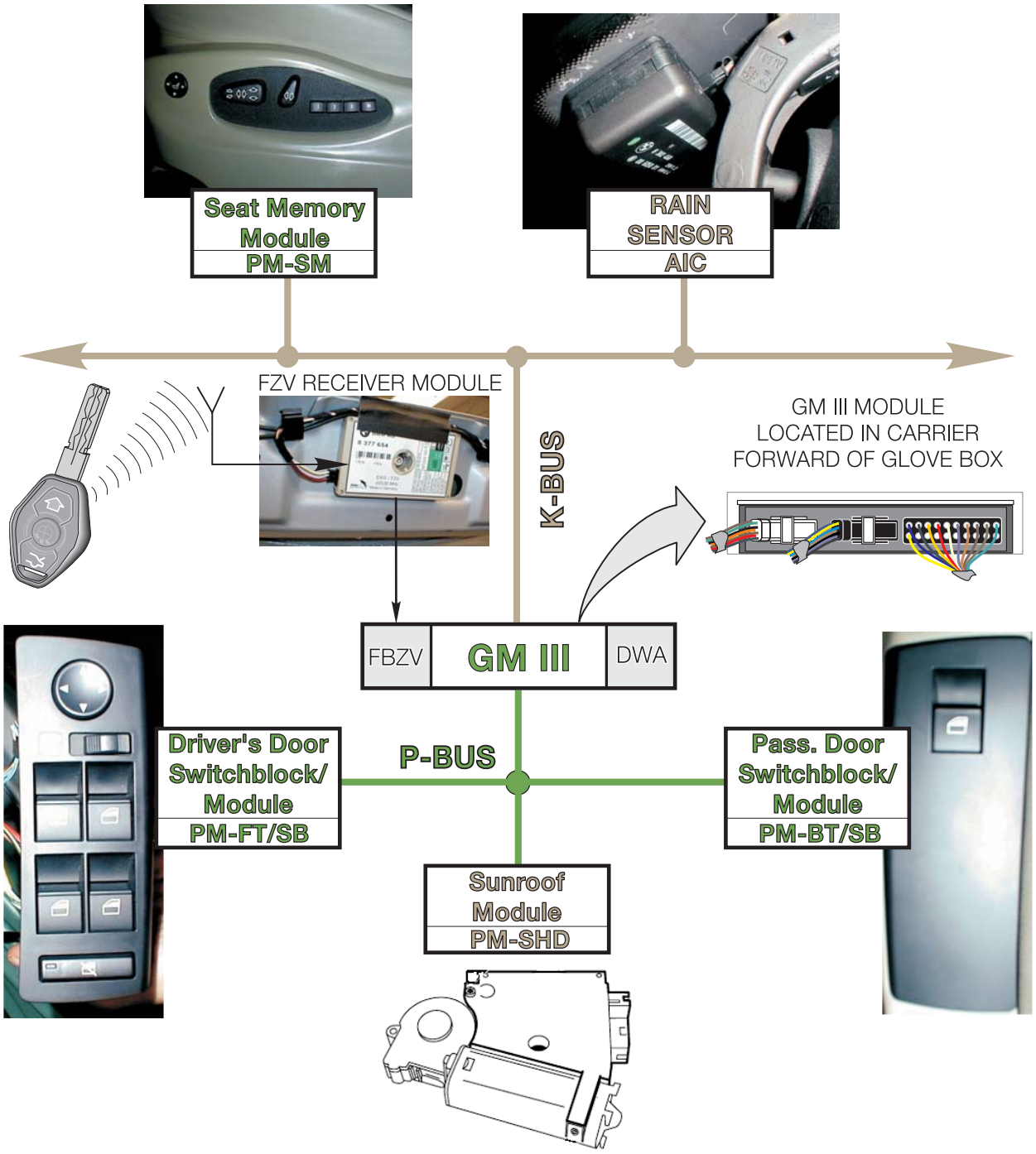


Note: Continuous operation of locking/unlocking will cause a timed arrest of the locking system. When activated, the timed arrest lasts for 2 minutes (or recycle the ignition KL15). The “crash” signal will override the timed arrest and unlock the vehicle.

Central Locking System Overview (IPO)



Bus System Overview (E53)

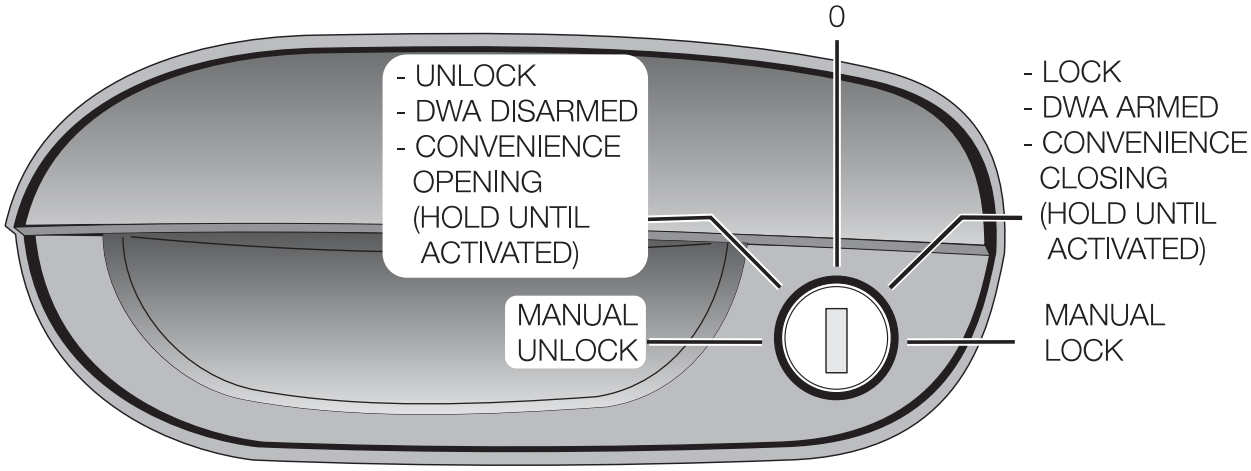


System Components

Driver's Door Lock

The lock/unlock signals from the driver's door lock cylinder are input to the driver's door module from the two microswitches on the lock cylinder. The driver's door switchblock module carries out the locking function of the driver's door.

The windows and sunroof can be closed or opened by holding the key in the lock/unlock



position (convenience closing/opening feature).

The signal to lock the remaining doors and fuel filler flap is passed over the P-Bus to the GM III and passenger's door module. The locking of the passenger's door is carried out by the passengers door module. The rear doors, luggage compartment and fuel flap locking are carried out directly by the GM III. All four doors will be pulled into the double lock position when locking from the driver's door.

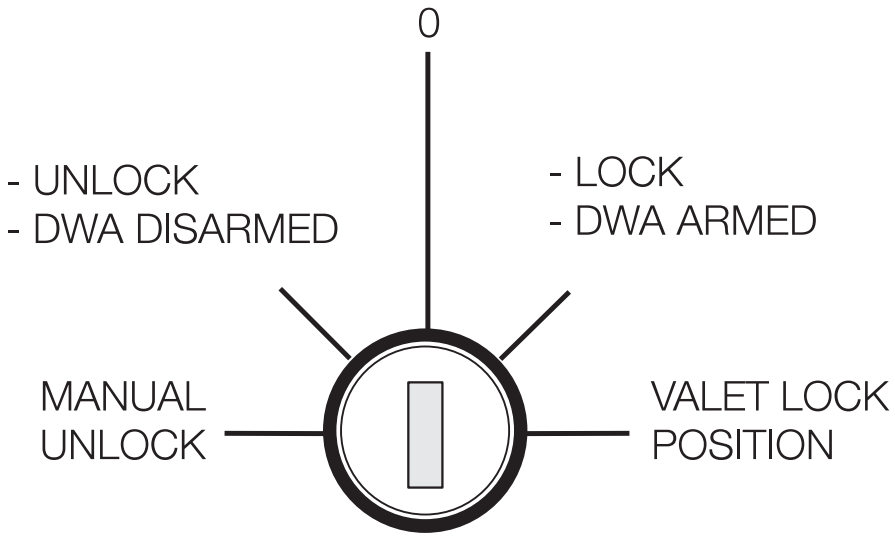
The control of the actuators in the front doors is through final stages in the door modules. The rear doors, trunk and fuel filler flap actuators are controlled by internal relays in the GM III. When locked, the GM III will not carry out any opening commands from the central locking button or luggage compartment interior release button.

Luggage Compartment Lock Cylinder (except E53/E39 Wagon)

The vehicle can be locked/ unlocked (prior to 2000 MY) from the luggage compartment lock cylinder. The lock/unlock micro switch inputs are processed in the GM III and the locking commands are carried out.

The signal is passed over the P-Bus to the door modules to lock/unlock the front doors and the GM III locks the rear doors and fuel filler flap.

All door actuators are placed in the double lock position. Removing the key in the horizontal position will activate the valet mode and prevent the valet key from opening the luggage compartment.

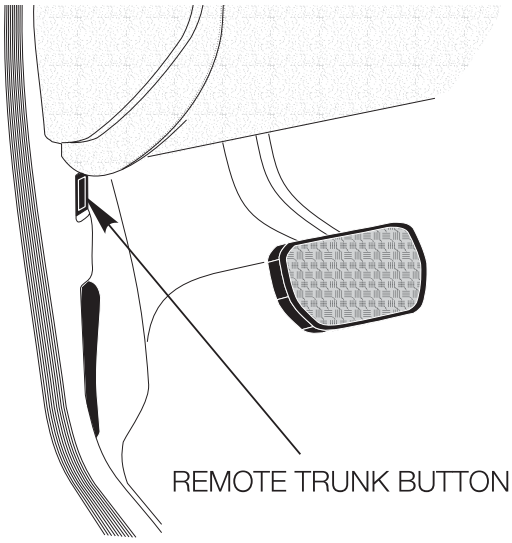


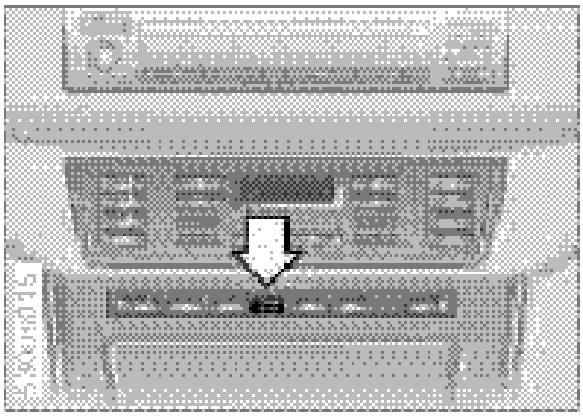
Luggage compartment Remote Unlock
The luggage compartment can be opened from inside the vehicle with the remote release button. This feature is also functions when the doors are locked from the central button.

The GM will disregard the remote release button input when the luggage compartment is mechanically locked with the Master Key (valet setting).

The GM will also disregard the release input if the vehicle speed is > 4 MPH.

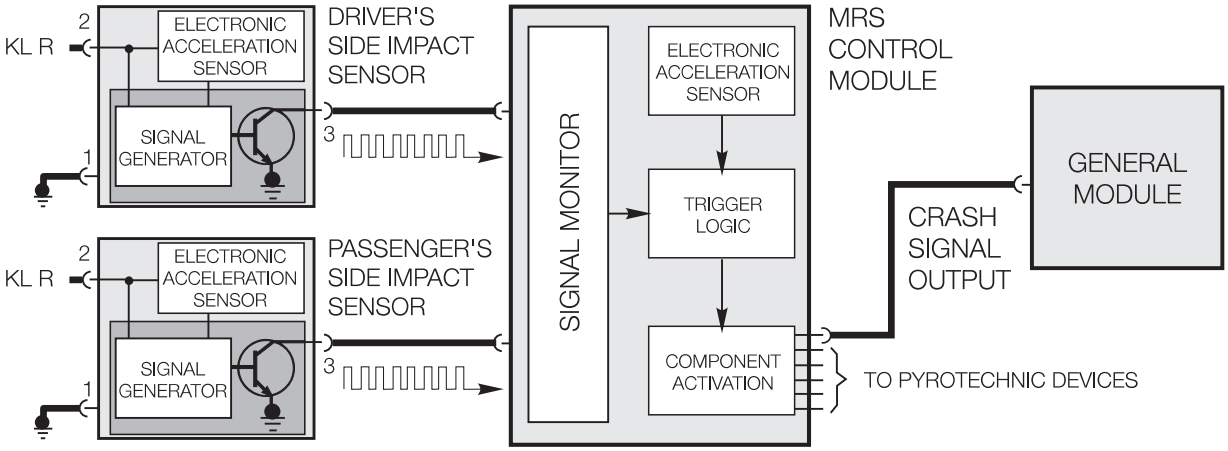
The E53 remote release button is located in the center console. This input will release the rear liftgate following the same criteria stated above.





Crash Signalling

The Multiple Restraint System (MRS) control module provides a switched signal to the GM in the event of an accident. This signal was previously provided by the crash sensor located in the left front kick panel (< 9/96 MY).



The signal is an output function of the MRS control module and becomes active when MRS determines a crash has occurred. The GM unlocks the vehicle, switches on the interior lights and flashes the exterior lights when this signal is active.

Door Lock Actuators

A door lock actuator contains an electric motor and an integrated microswitch (position switch). The rotary motor movement through the gear drive mechanically moves the locking latch.

When the lock actuator is operating, the motor is powered until the position switch signals the “locked” position. If the vehicle is locked from the exterior, the motor is powered further and the the gear mechanism is moved beyond the locked position into the “double lock”position. The motors must be powered (in reverse) to release the double lock. The inside door handles will not unlock a “double locked” vehicle.

E53 Door Lock Mechanism

The E53 utilizes a door latch combined with dual actuator motors. This type of actuator is sealed, self contained units with no replaceable parts. The door lock actuators use hall effect sensors in place of pin contacts/microswitches to provide:

- Door lock key position (driver’s door only)
- Door open/closed status (replaces door jamb switch).

The GM monitors the lock cylinder positions over two wires. The signals are generated by two hall effect sensors (Hall Sensor 1 & 2) located in the actuator.

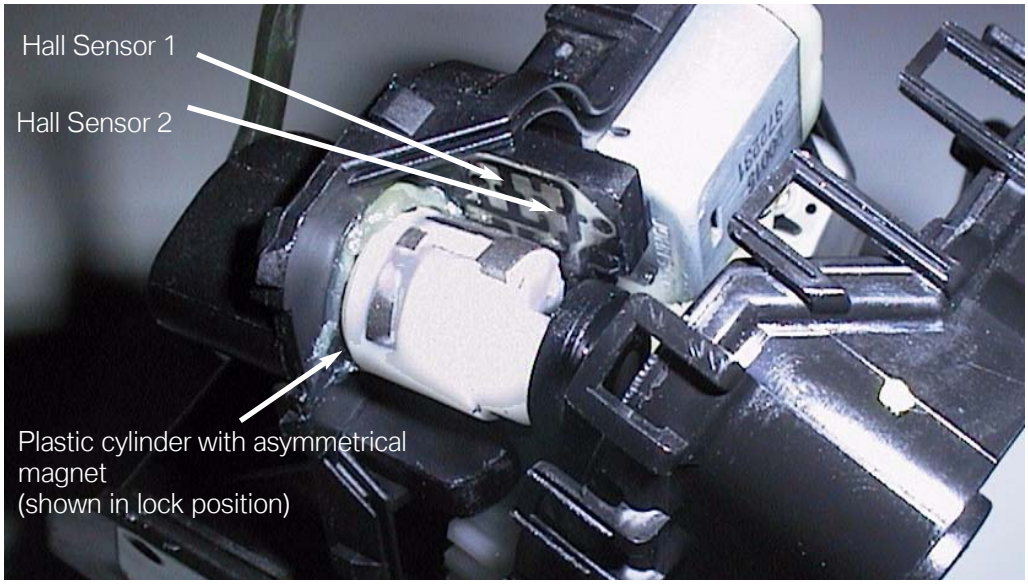
When the key is turned, a plastic cylinder in the lock actuator is simultaneously rotated by the lock tumbler extension rod.

An asymmetrical shaped magnet is incorporated in the plastic cylinder, which when rotated changes the magnetic influence on the hall sensors. The presence of a magnet in close proximity to the sensing surface of either hall sensor creates a coded input over the two wires that the GM uses to determine the key position.

- Magnet in front of sensor, current flow through the sensor is <5 mA (0).
- Magnet rotated away from sensor, current flow through the sensor is >12 mA (1).

Hall effect sensors improve the actuators reliability since they are impervious to moisture and there are no wear contacts.

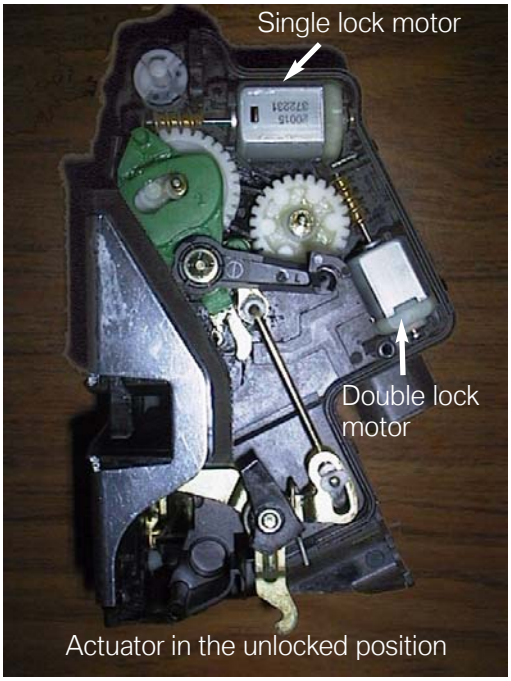
- Key in the neutral position, both sensors are simultaneously influenced by the magnet -0/0.
- Key turned to the unlock position from neutral, hall sensor 1 magnet segment moves away from hall sensor - 1/0.
- Key turned to lock position from neutral, hall sensor 2 magnet segment moves away form hall sensor - 0/1.



There are two motors incorporated in each actuator that provide two separate functions:

Single lock/unlock function
Also known as central lock, this motor controls the mechanical lock mechanism when the central lock button is pressed to single lock the vehicle.

The lock mechanism is fully locked at this point but can still be opened from the interior by pulling the appropriate interior door handle twice or by pressing the central lock button again. When single lock function is activated,the fuel filler flap actuator is not locked.

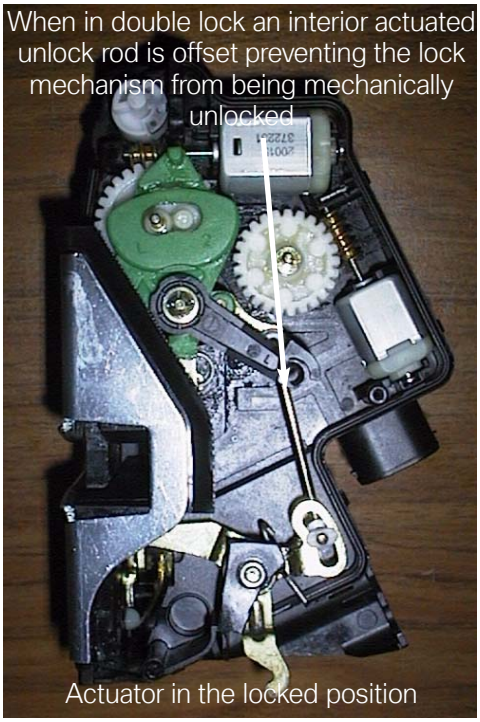


Actuator in the unlocked position

Double lock/unlock function
Also known as central arrest, this motor is activated only when the vehicle is locked from the exterior at the driver's door lock with a key or when the GM receives a lock request from the Key-less entry system. In this case the double lock motor is activated simultaneously with the single lock motor.

The function of the double lock motor is to mechanically offset an internal rod disabling it from unlocking the vehicle from the interior.

This prevents the doors from being unlocked by any means except from an unlock request at the driver's door or via the Key-less entry.



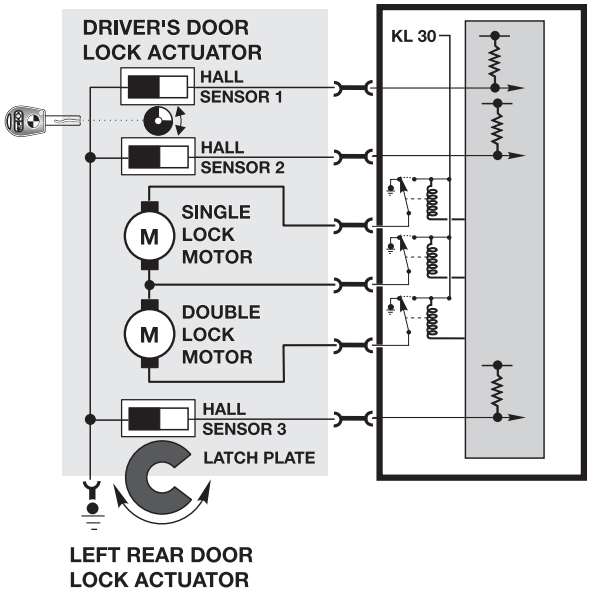
Actuator in the locked position

Door Contact Hall Sensor

Also included in the drivers door actuator is a third hall effect sensor. This sensor signals the door open/closed status to the GM. This sensor replaces the door jamb mechanical switch of previous systems. The rotary latch plate position activates the door contact hall sensor.

- When the door latch is closed, current flow through the sensor is <5 mA (0).
- When the door is open, current flow through the sensor is >12 mA (1).

The passenger side front door and both rear door lock actuators only include this hall effect sensor (hall sensor 3). Hall sensors 1 & 2 are not required.



Trunk Lid Close (E38) / Tailgate and Window Latching (E39/E53)

The tailgate/trunk lid is opened by any of the three input signals: FZV, remote button and unlock switch pad (push - trunk lock cylinder E38).

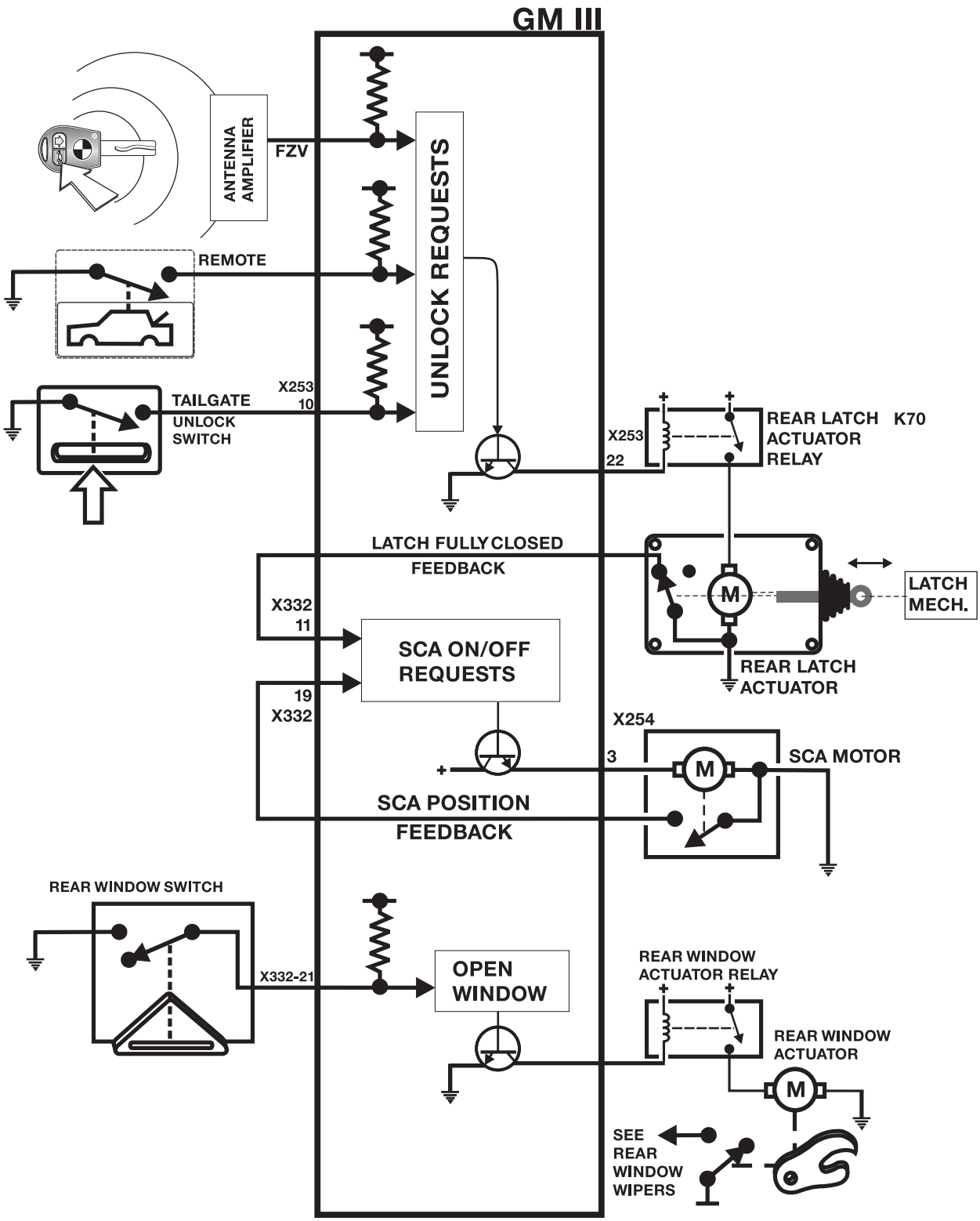
These inputs request the rear latch actuator control circuit to be switched to ground (exception:presence of road speed signal, key on with FZV request.)

The rear latch actuator unlatches the mechanism and signals the GM of the open latch status. The SCA motor rotates the striker 180°. Feed-back signalling stops the motor.

Note: E38 - When closing the trunk lid the trunk latch microswitch signals the GM to activate the SCA motor to pull the lid down.

Rear window unlatching is requested by the rear window switch ground signal. This signal initiates activation of the rear window actuator relay control circuit which activates the rear window actuator. The actuator unlatches the mechanism opening the window. The latch simultaneously provides an open window signal for the rear window wiper motor module as well as an interior light on request (via the wiper module).

Rear Trunk Lid Latching System (E39 Sportwagon)

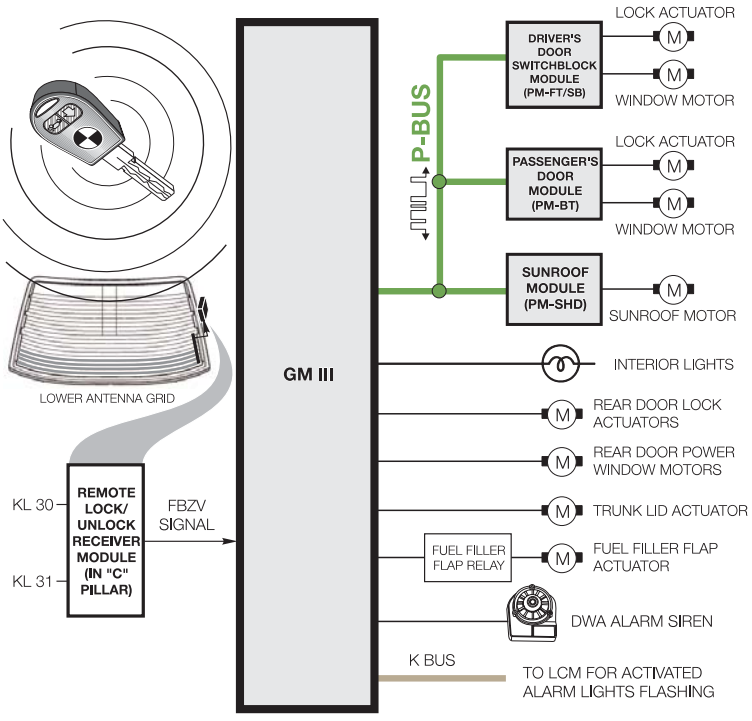


Remote (Keyless) Entry FZV

Introduction

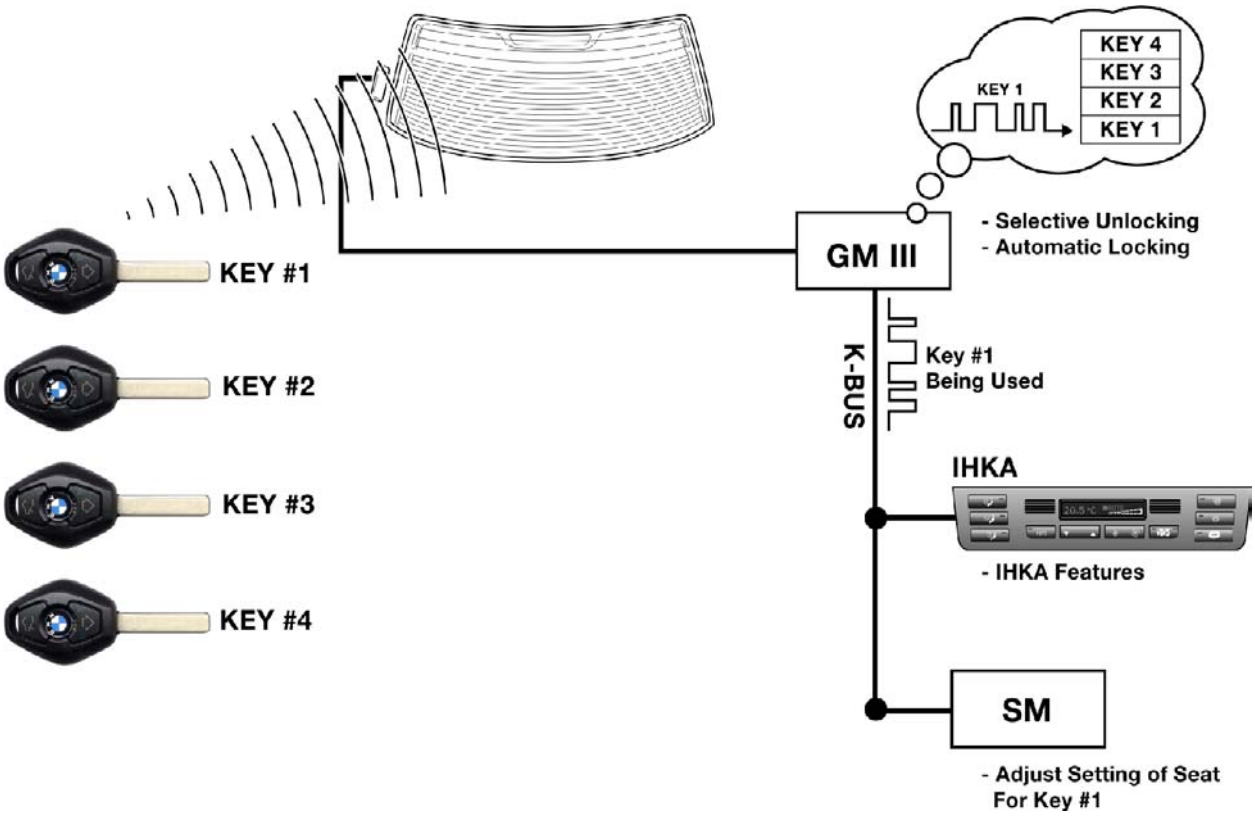
The Remote Entry System offers the following:

- Locking/unlocking of doors, luggage compartment (tailgate), fuel filler lid.
- Selective unlocking of driver's door (same as with key in the lock cylinder).
- Arming/disarming of DWA alarm system.
- Remote unlocking of the trunk (tailgate) only.
- Comfort opening of windows and sunroof.
- Interior lighting activation (search mode).
- Panic mode alarm activation.
- Changing code signals - coded signals from transmitter change with every operation.
- Automatic correction for up to 1000 erroneous activation signals.
- Transmitter initialization procedure - including up to four key operation and Key Memory.
- Replacement batteries.
- Low transmitter battery in vehicles equipped with Check Control.



The Remote Entry System incorporated minor changes since the original introduction which includes:

- The control electronics are incorporated into the GM III.
- The antenna is incorporated into the rear window lower heater grid.
- The remote key receiver is installed in the left “C” pillar. The receiver produces a digital signal based on the transmitter command and sends it to the GM for processing. The GM then carries out all remote entry operations either directly or through the door modules for the front doors. The frequency at which the key transmits the radio signal to the antenna amplifier is 315 MHz.



Vehicle/Key Memory

The Vehicle/Key Memory feature provides the flexibility of allowing the owner to customize certain functions of select vehicle systems and automatically identifies users of the vehicle by a key identification signal provided by the remote keyless entry system (FZV).

Vehicle & Key memory is marketed as a combined feature but is actually two separate functions of the select vehicle control systems.

Vehicle Memory

The owner is provided with a list of available system functions that can be customized to their liking. Prior to delivery, the DISplus or GT-1 is used to encode the owner's chosen selections into the appropriate control modules.

These choices become a permanent function of the control module and can only be changed by re-encoding with the DISplus or GT-1 at a BMW Center.

This feature has been available for some time via the ZCS Conversion Feature but has never been fully utilized or officially presented to the vehicle owner as a feature of their vehicle.

Key Memory

This feature provides the added convenience of identifying users of the vehicle whenever a lock or unlocked signal is generated via the individual FZV keys. A maximum of four FZV keys can be used with the Key Memory feature.

Each of the four keys generate a unique key identification signal (key number) that is transmitted simultaneously with the lock/unlock signals to the General Module. Key Memory does not respond to Lock/Unlock requests from the drivers door lock.

Most of the key memory functions require the vehicle be configured using the "KEY MEMORY" function of the DIS or GT-1. However, there are a few features that store settings automatically without configuration such as IHKA blower speed and temp setting. The key ID signal alerts the GM to communicate with select control systems over the K Bus to store (when locked) or reset (when unlocked) certain driver adjustable settings.

There are features that function as both a Car & Key Memory feature.

Example: the Automatic Seat Adjustment feature is encoded as a Car Memory Function with the following possibilities; when unlocking, when opening a door after unlocking, or not active at all.

If active, the seat positions are stored and reactivated by the Key Memory function for individual users of the car.

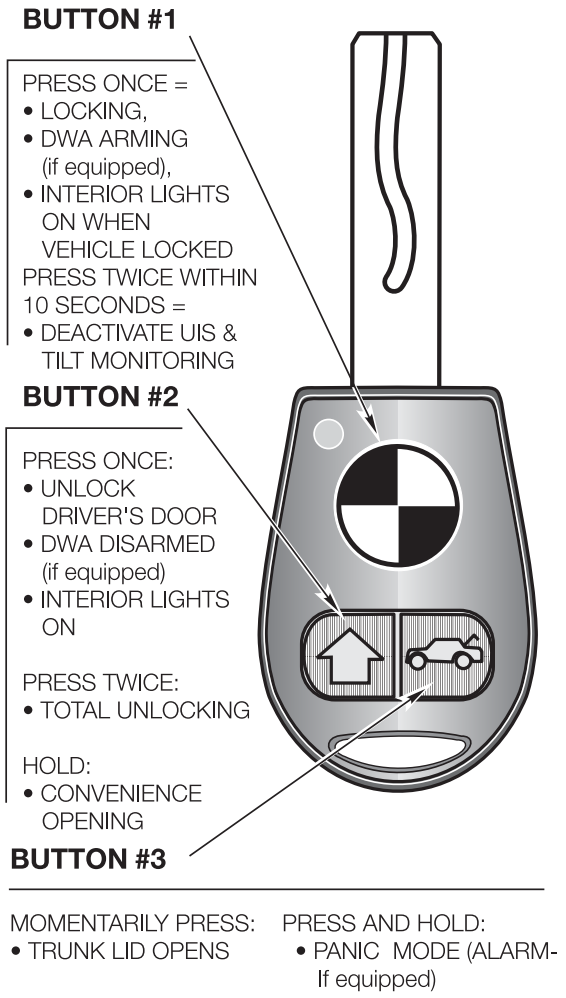
System Components

Remote Key

Features (Up to model year 2000):

- 3 volt lithium battery (commercially available CR 2016) is used as the power supply for the key transmitters.
- An EEPROM is used to store the key data. The data is not lost when the battery is replaced and initialization is not required.
- The key incorporates an LED that signals the operator of signal transmitting, key initialization status and key self test indication.
- The keys are delivered with a four color label sheet containing different colored labels for each of the four possible FZV keys.

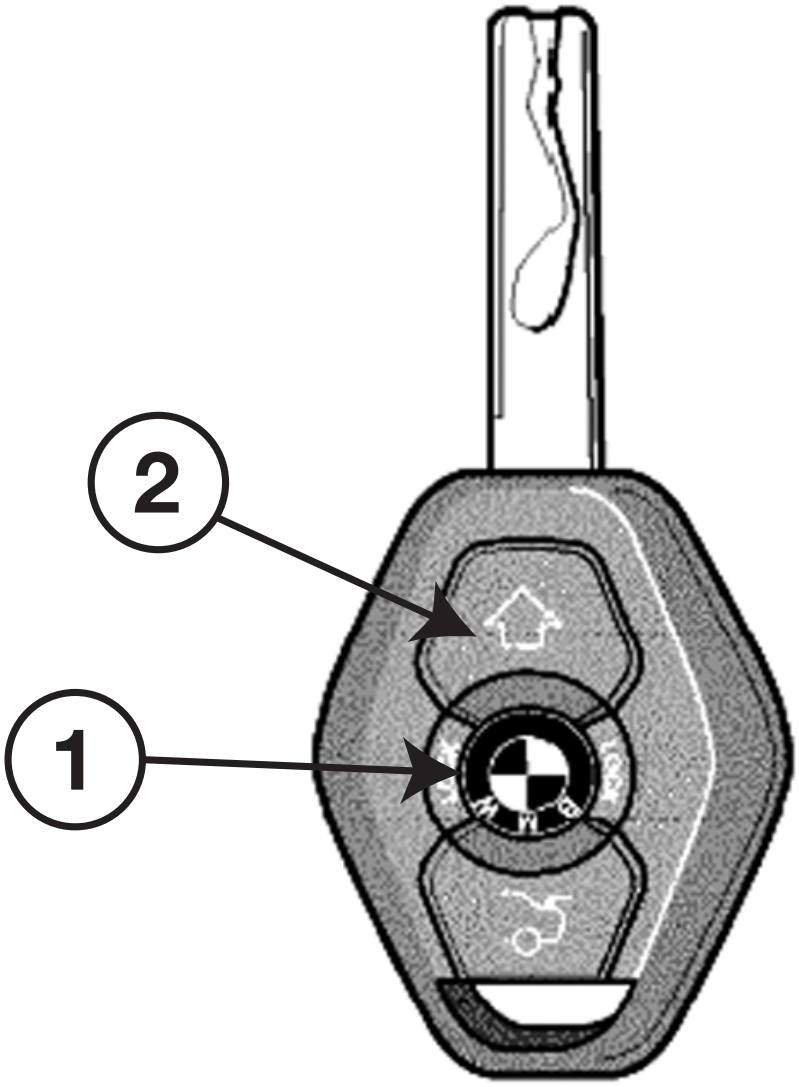
Note: This is helpful to differentiate the FZV keys during initialization preventing the possibility of mis-assigning the key ID which would change the encoded Key Memory functions.



Model Year 2000 Key

Visual Changes:

- New appearance with blue and white BMW roundel (1).
- New button arrangement (larger buttons) with sequential operation (enhanced operating convenience). Functions the same as the previous key (2).
- Rechargeable battery replaces replaceable batteries. Charged by EWS ring antenna.
- The key housing is encapsulated and can not be opened.
- The LED has been omitted.



Workshop Hints

Remote Key Initialization

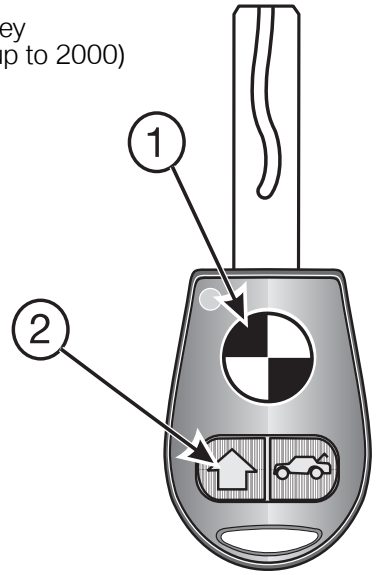
The initialization of the FZV keys is required to establish the Lock/Unlock signal synchronization with the GM. The initialization procedure provides the GM with a key identification number and a “rolling code” for each key. If the initialization is not performed, the GM will not respond to the key signals.

Up to 4 remote keys can be initialized. They must be initialized at the same time. Key initialization is only possible with the vehicle unlocked.

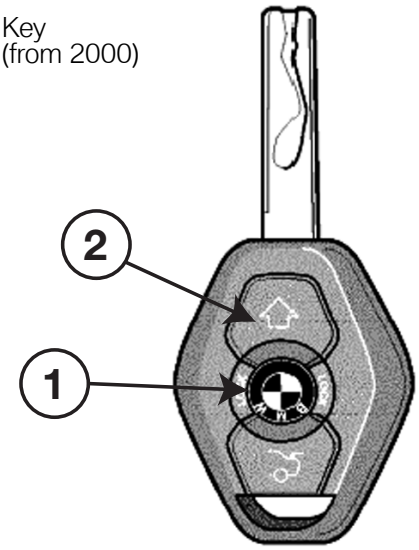
Procedure:

1. Close all doors and have all keys available.
2. Using key number 1, turn the ignition switch to KL R, then switch off within 5 seconds and remove the first key.
3. Within 30 seconds of turning the ignition switch to “off” Press and hold button #2.
4. While holding button #2, press and release (“tap”) button #1 three times within 10 seconds.
5. Release both buttons. The LED in the key will flash momentarily (except 2000 MY). The GM will immediately lock and unlock the doors signaling a successful initialization.
6. If additional keys need to be initialized repeat steps 3 - 5 within 30 seconds.
7. Switching the ignition to KL R completes the initialization.

Key
(up to 2000)



Key
(from 2000)



NOTE: The key memory function of the GM responds to the key identification number of each key. If the keys are not initialized in the same order prior to initialization, the key memory functions activated by the keys will not be assigned correctly.

Always initialize the keys in the same order.

LED Status (Keys equipped with LED)

The following functions can be checked with the LED:

- Flashing LED when pressing a button. Indicates that the data is being transmitted. (battery voltage between 3.2 - 2.6 volts)
- No LED activity when pressing a button:
    1. ZKE responds to pressed button only to unlock a locked vehicle. Indicates the battery is between 2.6 - 2.2 volts. Replace battery.
    2. No unlock of vehicle. Indicates battery is below 2.2 volts. Replace battery.

FZV Key Test

Pressing the trunk release and lock buttons together activates the key test. If the battery and FZV key EEPROM are “OK”, the LED will come ON for approximately 1 second.

FZV Key Rechargeable Battery

From KL R, the battery inside the key head is charged inductively by the EWS ring antenna via a coil antenna integrated in the key. The charging process is controlled by electronic circuitry integrated in the key.

- The service life of a radio-control key used under normal conditions corresponds to the vehicle lifespan.
- If the FZV keys are not used (ie: stored in a drawer), the battery will be discharged after approximately. 1.5 years.
- The time required to fully charge a discharged battery is approximately. 30 hours.
- The remote control can be operated about 15 times after a charging period of approximately. 30 minutes (driving time).

The key data is stored in a transponder chip. The transponder chip is a wireless read and write EEPROM. It is powered via the ring coil at the steering lock. Power is applied electromagnetically when the key is in the ignition switch from KL R.

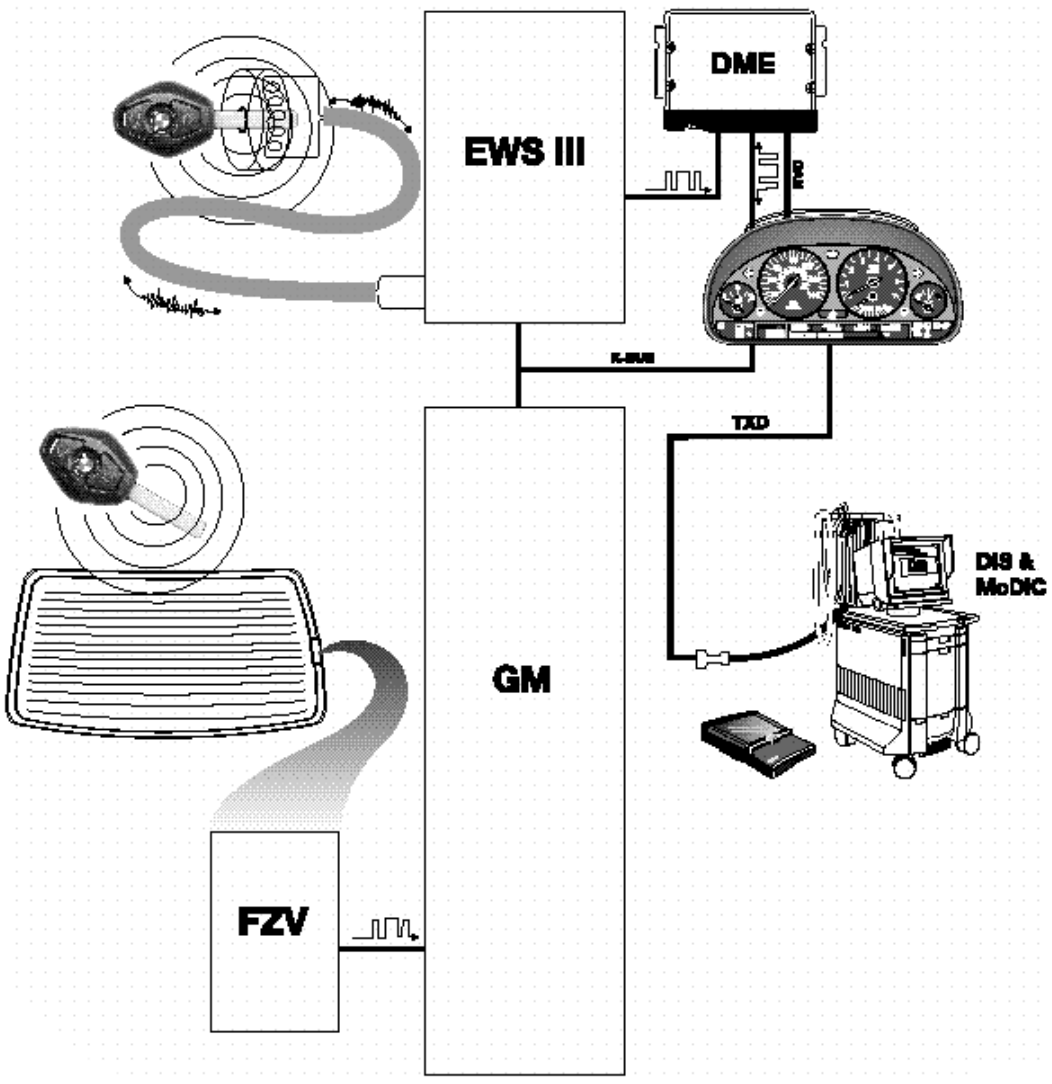
The power supply is used both for data transfer as well as for charging the battery. This has been made possible by new development of the transponder chip.

As with previous systems, every press of an FZV key also provides the battery charge condition. When the FZV electronics receives a low power condition message three successive times, the GM sets a fault indicating a low battery within a specific key. The LCM is also informed via the bus system and alerts the driver via an instrument cluster matrix message.

If the battery is recharged (used operate car), the fault will be automatically deleted when five successive messages are received indicating a charged battery condition.

Note: The battery has no affect on the EWS III communication function!

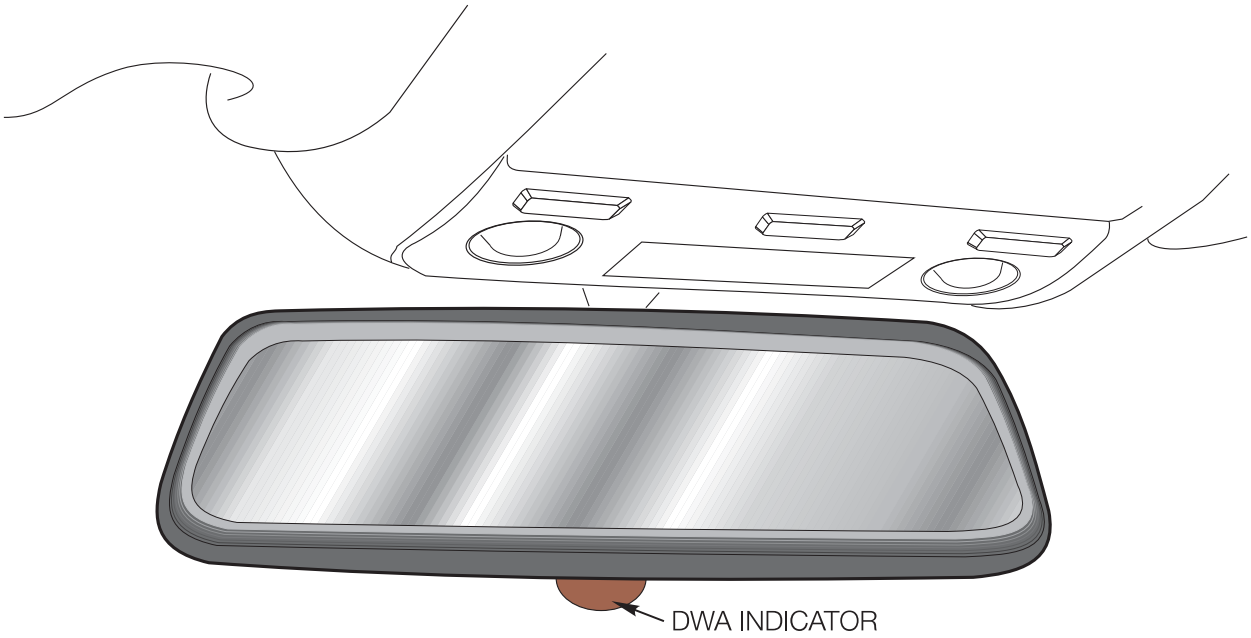
FZV Key Communication Overview



Anti-Theft (DWA) System

The DWA alarm system offers vehicle protection by monitoring the doors, hood, interior, luggage compartment and vehicle tilting. When activated, DWA deters theft by sounding an alarm siren for 30 seconds, flashing the low beam headlights (high beam on Xenon equipped models) and four way flashers for 5 minutes.

The control electronics for DWA are integrated in the general module. The DWA - LED indicator is located in the rear view mirror (E38 in the top center IHKA grille).



The system is “armed/disarmed” from the driver’s door lock cylinder, remote transmitter or luggage compartment lock cylinder. The alarm is immediately deactivated when disarmed with the key in the driver’s door lock cylinder (may be deactivated in Conversion) or remote
transmitter.

The GM utilizes existing components and/or circuits as part of the DWA system:

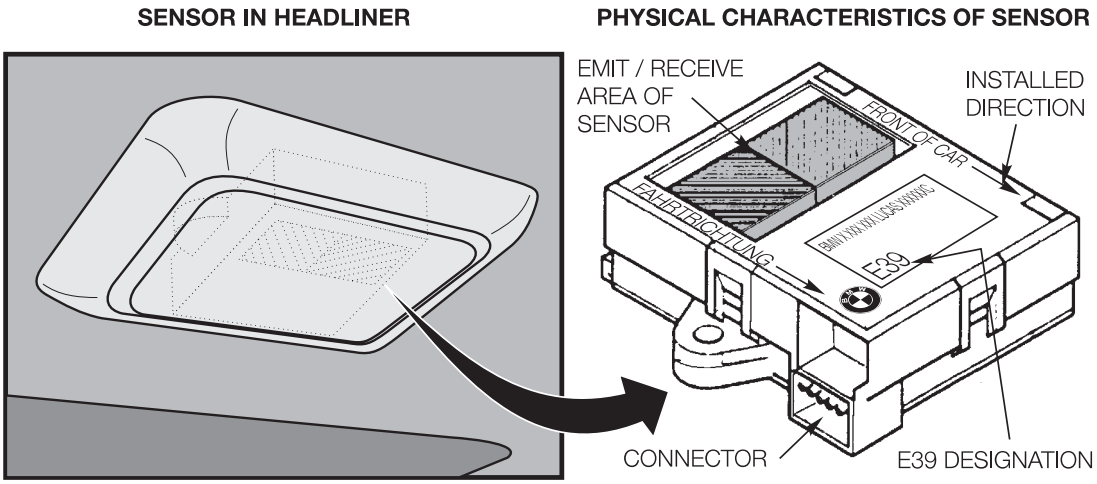
- Door latch switch/sensor contacts (door open/closed).
- Trunk lid switch contact (monitored for closed trunk).
- Trunk lock key position switch (located on the trunk lock, this switch signal prevents DWA from activating if armed when the trunk is opened with the key).
- Hood switch (monitored for closed hood, located under the hood).
- DWA status LED (part of rear view mirror).

The additional components required are the Interior Sensor (UIS), DWA Siren and the Tilt sensor.

System Components

Interior Sensor FIS (up to 99 MY)

The interior sensor is mounted in the center of the headliner panel. Due to the design of the vehicles interior, the sensor is uni-directional and must be installed in the proper direction to ensure proper operation of the system.

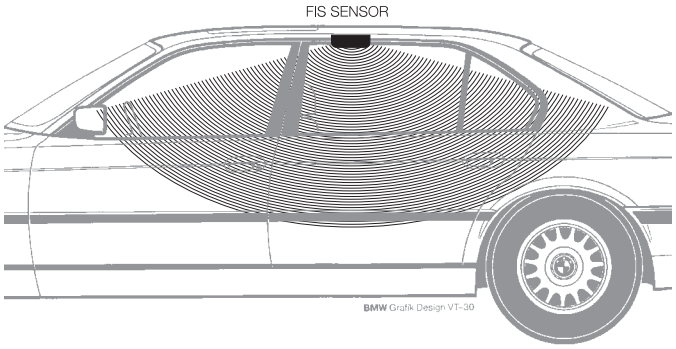


When the alarm system is armed, the sensor emits electromagnetic waves at a frequency of 2.45 GHz. As long as nothing is moving in the vehicle, the waves as bounced back to the sensor at the same frequency. The sensor monitors these bounced back waves as an indication that nothing is disturbed within the vehicle.

If a foreign object enters the vehicle, the frequency of the bounced back signal changes. The sensor monitors the changed frequency and triggers the alarm.

Every time the DWA system is armed, the sensor adapts to what ever objects might be stationary in the interior. This allows packages or objects to be left inside the car without effecting the operation of the system. The sensitivity of the sensor is set so that the moving object must be at least as large as a bumble bee. This prevents a false alarm from occurring from small insects that might be caught in the vehicle.

The FIS is switched OFF when the vehicle is locked two times within ten seconds. The LED will flash one time for confirmation. This allows the sensor to be switched OFF to avoid false alarms when the windows are left open for venting.

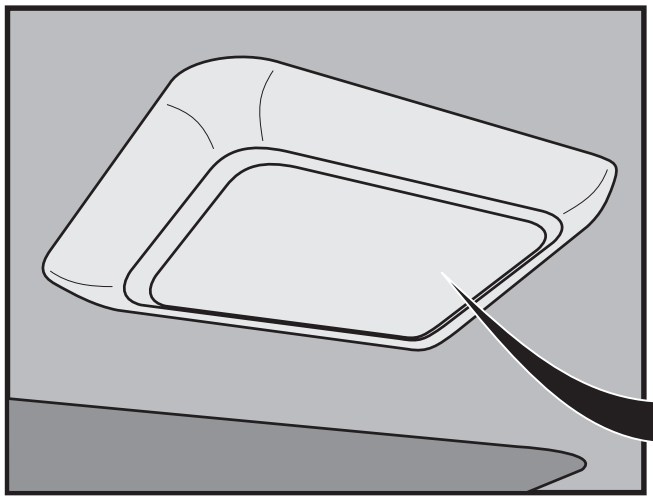


Interior Sensor UIS (after 99 MY)

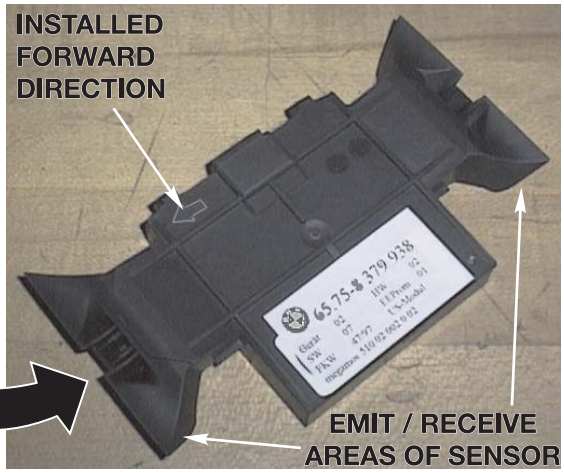
Similar to the FIS, the UIS monitors the vehicle interior for motion. The UIS uses ultrasonic sound waves instead of microwaves (less susceptible to magnetic interference). The UIS is a combined transmitter and receiver.

The interior sensor is mounted in the center of the headliner panel. Due to the design of the vehicles interior, the sensor is uni-directional and must be installed in the proper direction to ensure proper operation of the system (trim cover ensures directional installation).

SENSOR IN HEADLINER



PHYSICAL CHARACTERISTICS OF SENSOR



Every time the DWA system is armed (signal STDWA), the sensor adapts to what ever objects might be stationary in the interior. The sensor emits ultra sonic waves in a programmed timed cycle. It receives echos of the emitted waves.

The UIS amplifies the received sound wave signals and compares them with the transmitted waves. The UIS also checks the incoming echos for background hiss (wind noise through a partially open window) and adapts for this.

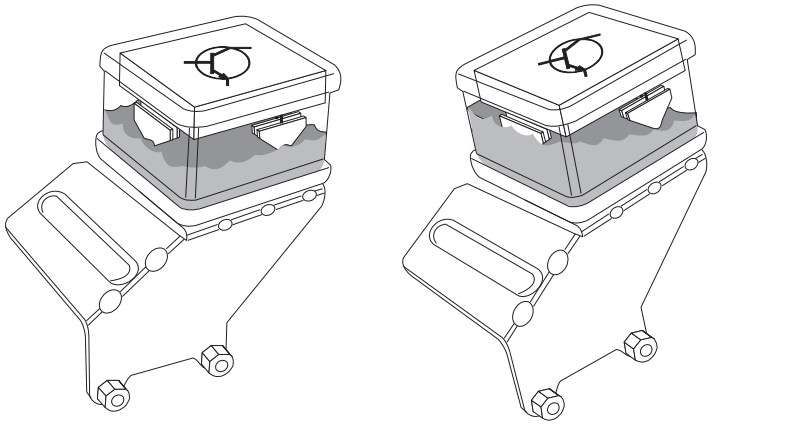
- If the echos are consistently similar, no movement is detected.
- If the echos are altered, (inconsistent), the UIS determines motion in the interior compartment.

If motion is detected, the UIS changes to a constant cycle and the echo is compared again. If the inconsistency is still present the UIS sends the activate siren signal (INRS) to the GM.

The UIS is switched OFF when the vehicle is locked two times within ten seconds. The LED will flash one time for confirmation. This allows the sensor to be switched OFF to avoid false alarms when the windows are left open for venting.

Tilt Sensor (Liquid Type - E38/E39 to 97 MY)

The Tilt Sensor consists of a conductive liquid chamber, a processor board and metal probes (located in the luggage compartment). The probes are submersed in the liquid and produce a resistance value dependent on the tilt of the sensor (angle of vehicle). This resistance value becomes the static point when the DWA System is armed.



1. DWA ARMED, TILT SENSOR REGISTERS RESISTANCE VALUE THROUGH FLUID. SIGNAL HIGH TO GENERAL MODULE

2. VEHICLE TILTED, FLUID MOVES AND CHANGES RESISTANCE VALUE BETWEEN PLATES. HIGH SIGNAL MOMENTARILY GOES LOW SIGNALLING GM TO ACTIVATE THE ALARM.

If the vehicle is jacked-up or lifted, the angle of the liquid changes producing a change in the resistance value. The sensor recognizes this change and signals the GM to activate the DWA alarm.

The resets at the new angle. This allows the DWA to remain armed and re-activate the alarm if the vehicle is moved again.

As with the interior sensor, the tilt sensor is also switched OFF when the vehicle is locked two times within ten seconds. The LED will flash one time for confirmation. This allows the sensor to be switched OFF for transportation purposes.

Tilt Sensor (Electronic Type from 98 MY)

Located in the luggage compartment area, the tilt sensor is an electronic sensing device with the sole purpose of monitoring the vehicle's parked angle when DWA is armed.

The sensor requires three signal wires to function:

- KL 30 - Constant battery voltage
- Signal "STDWA"; switched ground input signal provided by the GM indicating DWA armed/disarmed status.

  The tilt sensor is used as a splice location for the STDWA signal to the Siren and UIS interior protection sensor.
- Signal "NG"; switched ground output signal provided to the GM. The signal is used for two purposes,

  1. As a momentary acknowledgment that the tilt sensor received STDWA and is currently monitoring the vehicle angle.
  2. If the tilt sensor detects a change in the vehicle's angle when DWA is armed, signal NG is switched to inform the GM to activate the siren.

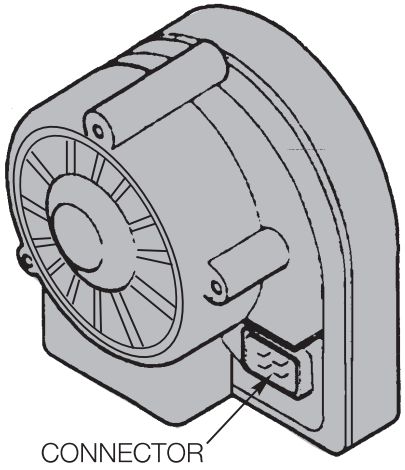
When the tilt sensor receives the STDWA signal from the GM it memorizes the vehicle's parked angle. The angle of the vehicle is monitored by the solid state electronics. Once armed, if the angle changes, the tilt sensor provides a switched ground signal to the GM to activate DWA.

As with the interior sensor, the tilt sensor is also switched OFF when the vehicle is locked two times within ten seconds. The LED will flash one time for confirmation. This allows the sensor to be switched OFF for transportation purposes.

Glass Breakage Sensors (Early E38 - before FIS Sensor)
The door windows (including the rear quarter glass wire loop) are monitored by inductive sensors mounted on the inside of the door behind the trim panel. A closed window is recognized by a magnetic plate on the glass lining up with the sensor.

If the glass is broken, the plate falls away and the signal from the sensor changes and the GM will activate the alarm.

Alarm Siren
The alarm siren is mounted in the rear wheel well, behind the inner wheel housing cover (early E38 used an alarm horn). The E53 alarm siren is located in the left side of the engine compartment.

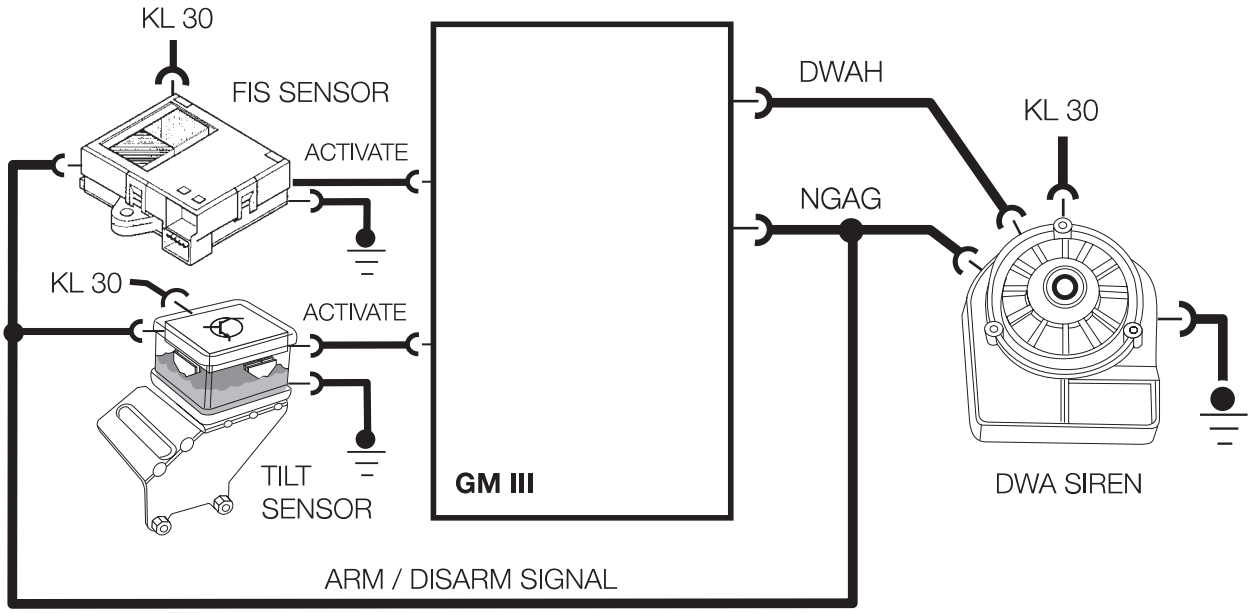


The siren contains electronic circuitry for producing the warning tone when the alarm is triggered. The siren also contains a rechargeable battery that is used to power the siren when the alarm is triggered.

The rechargeable battery will allow the siren to sound if it or the vehicle’s battery is disconnected. The siren battery is recharged, from the vehicle’s battery, when the alarm is not in the armed state.

The siren has four wires connecting it to the system; KL 30, KL 31, activate siren signal (SIRENE) and the arm/disarm signal (STDWA).

The arm/disarm output signal from the GM is provided to the Tilt sensor, FIS/UIS sensor and the siren. The arm/disarm signal is a switched ground that signals the components of an armed/disarmed status.

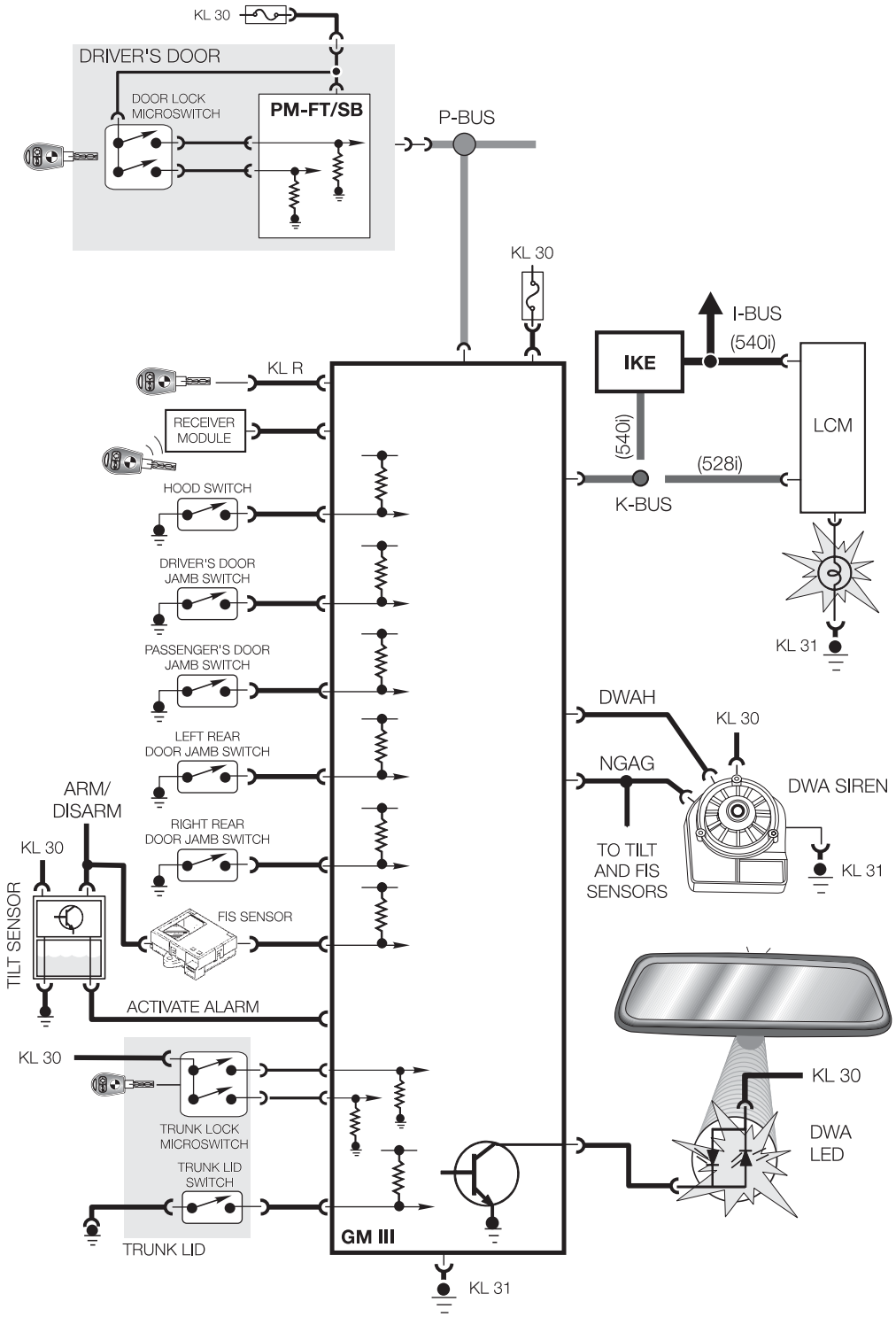


The activate siren signal to the siren is high whether DWA is armed or disarmed. If a monitored input activates the alarm, the high signal to the siren is switched to a 50% duty cycle at the GM. The control circuitry in the siren activates the siren driver.

If the DWA is armed and the battery is disconnected the siren recognizes the normally high “SIRENE” signal as suddenly going low, the siren is activated.

DWA System Overview (IPO)

E39 Shown



Principle of Operation

DWA Arming/Disarming

- The DWA is armed every time the vehicle is locked from the outside with the door lock cylinder or FZV key.
- The DWA LED flashes as an acknowledgment along with the exterior lights and a momentary chirp from the siren.
- The GM monitors all required input signals for closed status (door closed, luggage compartment closed, etc.) The inputs must be in a closed status for a minimum of 3 seconds for the GM to include them as an activation component. If after 3 seconds any input signal not in the closed status is excluded (this is acknowledged by the DWA LED) preventing false alarm activations. The hood switch can be “lifted” to the service position to test the alarm with the hood open.
- If the DWA is armed a second time within 10 seconds, the tilt sensor and interior protection sensor are excluded as alarm activation components. This function is useful if the vehicle is transported on a train or flat bed truck to prevent false alarm activations.
- While armed, the trunk can be opened with out the alarm being triggered as follows:
    - If opened with the trunk remote button via the FZV, the GM prevents the alarm from activating. (This feature is customizable under the Car Memory function).
    - If opened with the key at the trunk lock cylinder the trunk key position switch signals the GM and in the same manner prevents the alarm from activating.

In either case, when the trunk is returned to the closed position, it is no longer considered as an activation signal.

Panic Mode Operation

When the trunk button is pressed and held, the GM is signaled to activate the siren for the Panic Mode. The panic mode is function with either an armed or disarmed DWA system.

Emergency Disarming

Emergency disarming occurs automatically if a key is used to turn the ignition switch on and the EWS accepts it. The EWS signals the GM to unlock the doors and deactivate the DWA.

Alarm Indication

When the alarm is triggered, the siren will sound for 30 seconds. At the same time the low beam headlights (high beams on Xenon equipped vehicles) and four way flashers for 5 minutes.

The GM signals the LCM via the bus system to flash the lights. Following an alarm activation, the system will reset and activate again if further tampering occurs.

DWA LED Status

DWA Status	DWA LED Condition
Disarmed	OFF
Armed	Continual slow flash
Armed with one or more monitored inputs not in closed position then continual slow flash. (ie: trunk not fully closed, etc)	Rapid flash for 10 seconds, then continual slow flash
Alarm activated	Rapid flash for 5 minutes, then continual slow flash
Rearmed in less than 10 seconds	ON for 1 second
Disarmed after activated alarm	Rapid flash for 10 seconds, then OFF

Workshop Exercise

Using an instructor designated vehicle, perform a complete vehicle short test. Using the "Component Activation" menu, lock and unlock selected doors. Access the "Status requests" menu and view status pages pertaining to central locking.

How is this information helpful in diagnosis?

Using a suitable fused jumper, ground the P-Bus at the driver's side switchblock. Observe the operation of central locking and re-check fault memory (short test).

What is observed regarding the operation of central locking when the P-Bus is not operational? (fault codes, functionality etc.)

Notes:

Workshop Exercise - Diagnosis

Using an instructor designated vehicle, diagnose the concern indicated by the instructor. Complete this worksheet using the proper "Complaint, Cause and Correction" format.

Vehicle: _____ Chassis #: _____ Production date: _____

Complaint:

Cause:

Correction:

Classroom Exercise - Review Questions

1. What occurs when the central lock is used to lock the vehicle? (what locks and what does not lock?)

2. For what reason is the EWS system interfaced with the Central Locking System?

3. During an accident with airbag deployment, What role does the ZKE system play in customer safety?

4. What are some of the differences between the vehicle key from 2000 model year as compared to the previous vehicle key?

5. What are the differences between the FIS sensor and the UIS sensor?

Classroom Exercise - Review Questions

6. How is the interior sensor (UISor FIS) deactivated and Why would this need to be done?

7. How is “Panic Mode” initiated?

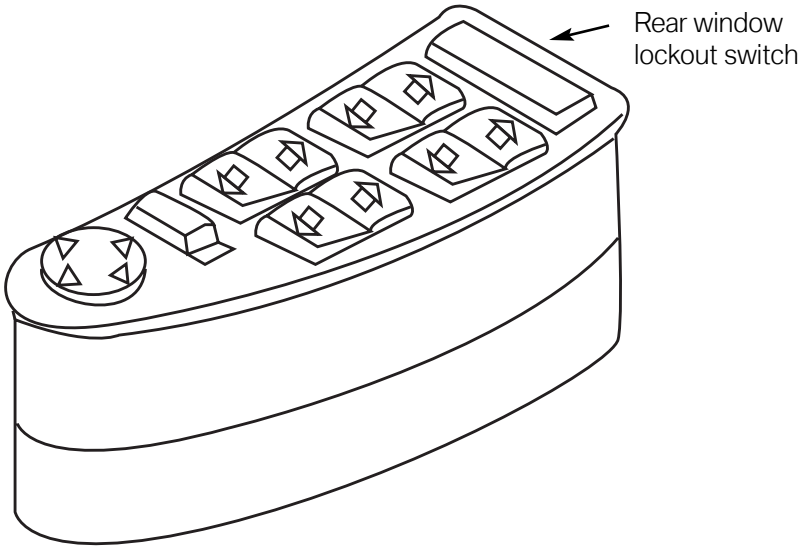
8. What is indicated when the DWA LED flashes rapidly for 10 seconds when arming?

9. How does the GM activate the exterior lights when the DWA is triggered? (What is the bus signal path?)

Power Windows/Sunroof

The features of the power windows and sunroof system include:

- One-touch operation in both directions (up/down) on all four windows.
- The cable design window regulator is used for all windows.
- Anti-trap detection is through the use of the pressure sensitive finger guard.
- The control of the front window motors is carried out in the respective door modules.
- The control of the rear windows is carried out in the GM III.
- The switch block/module on the driver's door panel controls all four windows and the rear window lock out feature.



System Components

Driver's Door Switch (switchblock)

The signals from the switch block pass through the driver's door via the P-Bus and on to the GM III and passengers door module.

Each window switch has four positions.

Two for the standard mode of operation:

- Push to first detent and hold to raise/lower the window (1).

Two for the one-touch mode:

- Push to second detent and quickly release (quick strike) to automatically raise/lower the window (2).

All window operations signals are digital inputs to the door module and GM III.

- Comfort closing/opening of the windows from the driver's lock cylinder. The remote key provides opening only.
- When the ignition key is in accessory or "on" position press the switch to open or close the windows. Window operation is possible with the ignition switched off until a front door is opened or 16 minutes (maximum) has elapsed.
- Window load switching is through relays. The front window control relays are located in the door modules, the rear window relays are in the GM III. The GM III monitors the current draw for end limit position. The maximum run time for the window motors is limited to 6 seconds in the one-touch mode. This allows the motors to be switched off if the end limit load sensing fails.

E53 Style Window Switches

The E53 power window switch design is a push - pull type switch. Each switch provides the GM with the coded ground signaling strategy as previous two wire switches.

Pushing a switch to the first detent and holding provides a single ground signal on one wire requesting the GM to operate the window motor in the down direction.

When released, the ground signal is removed and the window motor stops.

Momentarily pushing the switch to the second detent and releasing provides an additional ground signal on the second wire requesting the "one touch mode", operating the window motor automatically.

The motor runs the window down until it reaches the end stop.

The switch functions in the same manner for the upward run of the window motor but the ground signal sequencing is reversed.

Rear Window Child Lockout Switch

The rear window child lockout switch is incorporated in the driver's side window switch block. It provides a constant ground signal to the GM preventing the windows from being operated from the rear door switches.

The lockout switch ground signal is overridden by the GM if the MRS crash signal is activated (MRS III equipped vehicles).

Window Anti-Trap Detection

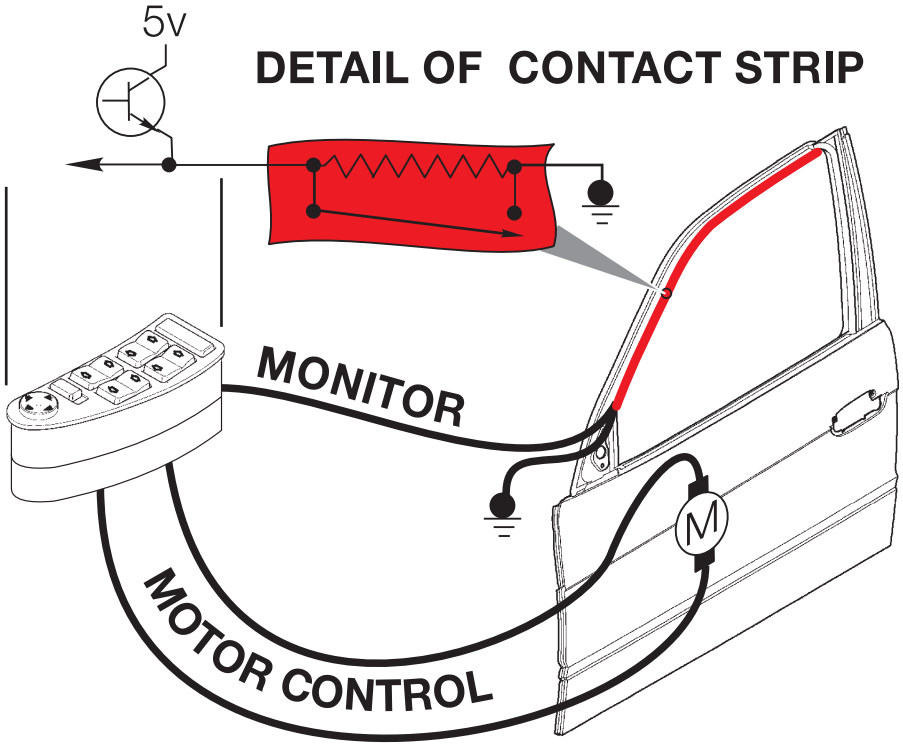
Each pressure guard at the top edge of each door frame consists of two contact strips that close when subjected to pressure. This provides anti-trap for the full travel of the window.

When the contact strips close, the window will reverse direction. The contact strip does not require that the anti-trap feature be initialized prior to operation.

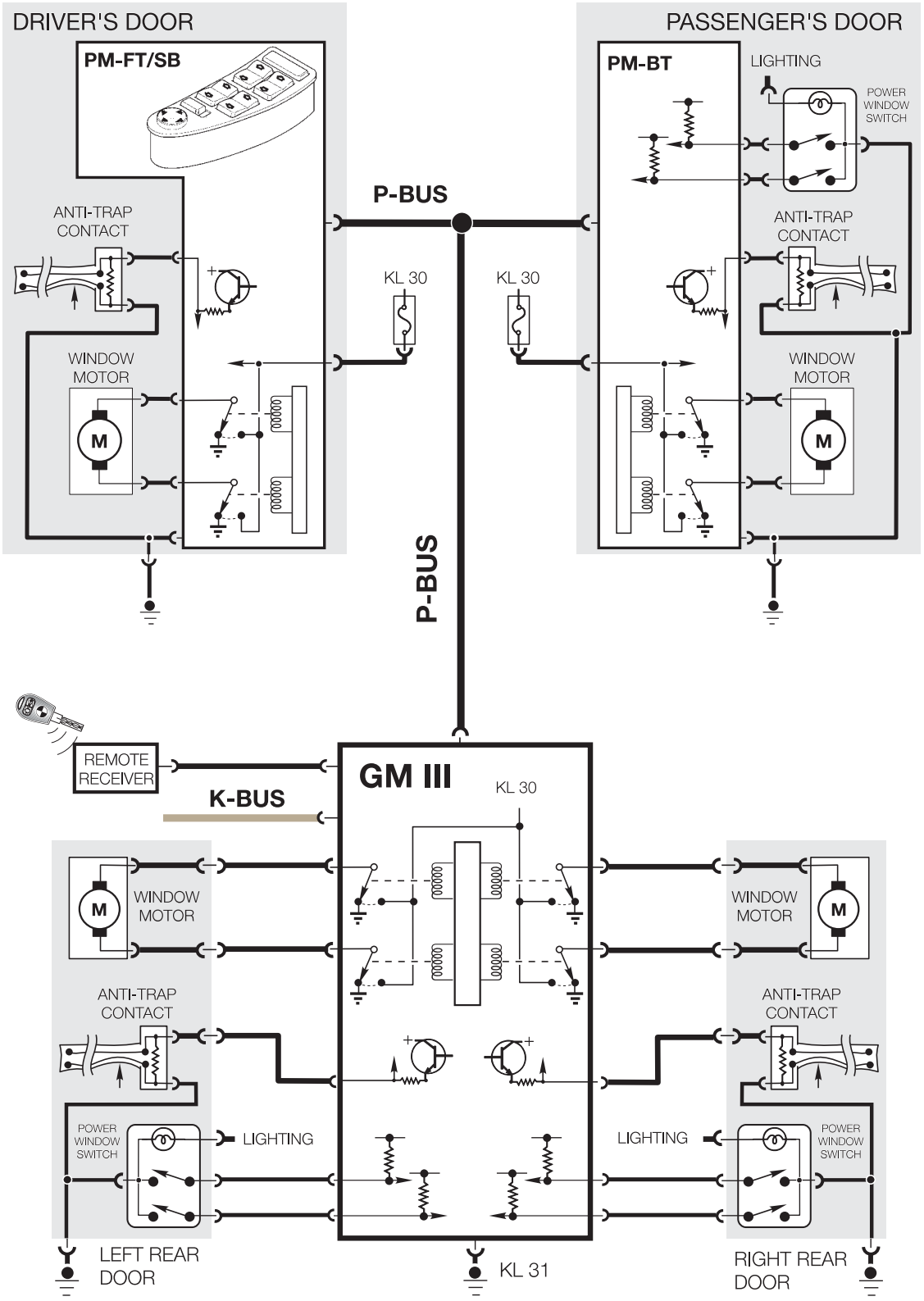
The finger guard has a resistance of 1.2 KOhm and it is monitored for open circuits. Faults with the anti-trap system require that the window switch be held to close the window.

The example shown represents the driver's door window control and monitoring carried out by the Driver's Door Switchblock Module (PM- FT/ SB).

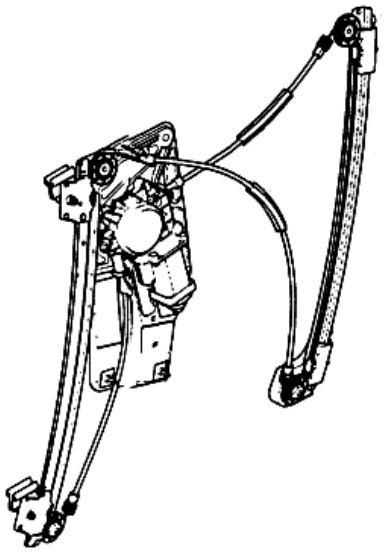
The passenger door window is controlled and monitored by the Passenger door module (PM-BT) and the rear door windows are both controlled and monitored by the General Module.



Power Window Overview (IPO)



Power Window Motors



The window motors are mounted on the cable regulators. The window motor control circuit consists of two wires for operating the motor in both directions.

The motors are activated by relays in the GM of door modules (front doors). The relays provide either power or ground depending on the direction of window travel.

The GM controls the polarity of the motor based on a request to run the window (window switch, Convenience Opening/ Closing).

The windows are run to the limit stops which is detected by an amperage increase in the control circuit.

Additionally, the window run cycle is limited to a 6-8 second duration if in case the amperage increase is not detected or there is a malfunction with the regulator.

Window Motor Limit Stop Function

If the windows are run up and down continuously a limit stop function is activated to prevent the window motors from overheating. The GM monitors the number of times the window motors are activated. Each cycle is counted and stored in memory.

If the repetitive window activation (up/down) exceeds one minute, the GM deactivates the internal relays and disregards any further input requests. The GM provides motor activation after a short duration but not for the full one minute monitoring cycle. Over time, the GM slowly reverses the stored count of activation until the stored number equals 0.

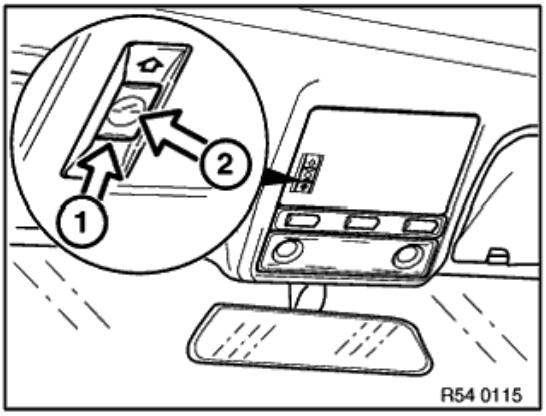
Convenience Opening/Closing

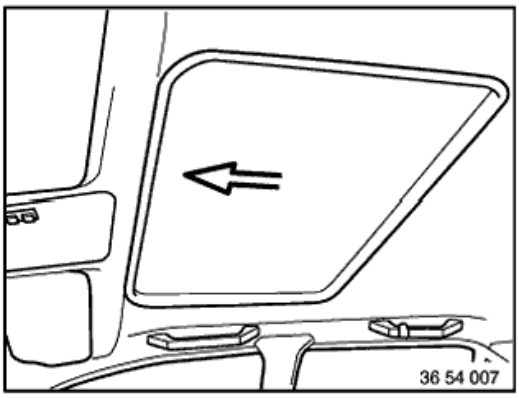
The GM provides the convenience open/close feature providing control of the power windows (and sunroof) from outside the vehicle with the key in the driver's door lock cylinder. The FZV provides the same function for the opening only.

- The anti-trap feature is active during convenience closing from the driver's door lock.
- The convenience open feature provides outside activation of the windows and sunroof in the same manner.
- If the GM receives a request to operate convenience close or open for more than 110 seconds, the function is deactivated and a fault code is stored.
- The Car Memory Feature can activate and deactivate the Convenience Open Feature from the FZV's control.

Sunroof

When the ignition key is in accessory or “on” position press the switch or slide it to the desired direction to lift (2), open (1) or close the sunroof.





When lifting, the headliner retracts several inches. The sunroof can continue to operate after the ignition has been switched off as long as one of the front doors has not been opened.

Mechanically, the sunroofs are similar in design. Some vehicles are equipped with the steel roof while others are equipped with the glass (moon) roof.

The anti-trap feature of the sunroof uses a hall sensor to detect obstructions while the sunroof is closing. The initialization procedure must be carried out to allow the sunroof to operate in the opening direction and allow the anti-trap feature to function. The anti-trap is shut down 4mm prior to full closed and during the tilt closing function.

System Components

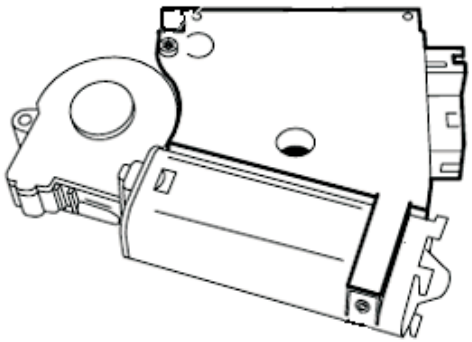
Sunroof Switch

Mounted in the sunroof motor trim cover, the switch provides coded ground signals for system operation. The following signals are generated over three wires:

- Rest position.
- Slide open request (press and hold switch to first detent of open position).
- Automatic slide open request (press further to second detent and release).
- Tilt open (press and hold).
- Slide close request (press and hold switch - first detent of close direction).
- Automatic slide close request (press further to second detent and release).

Sunroof Motor/Module (SHD)

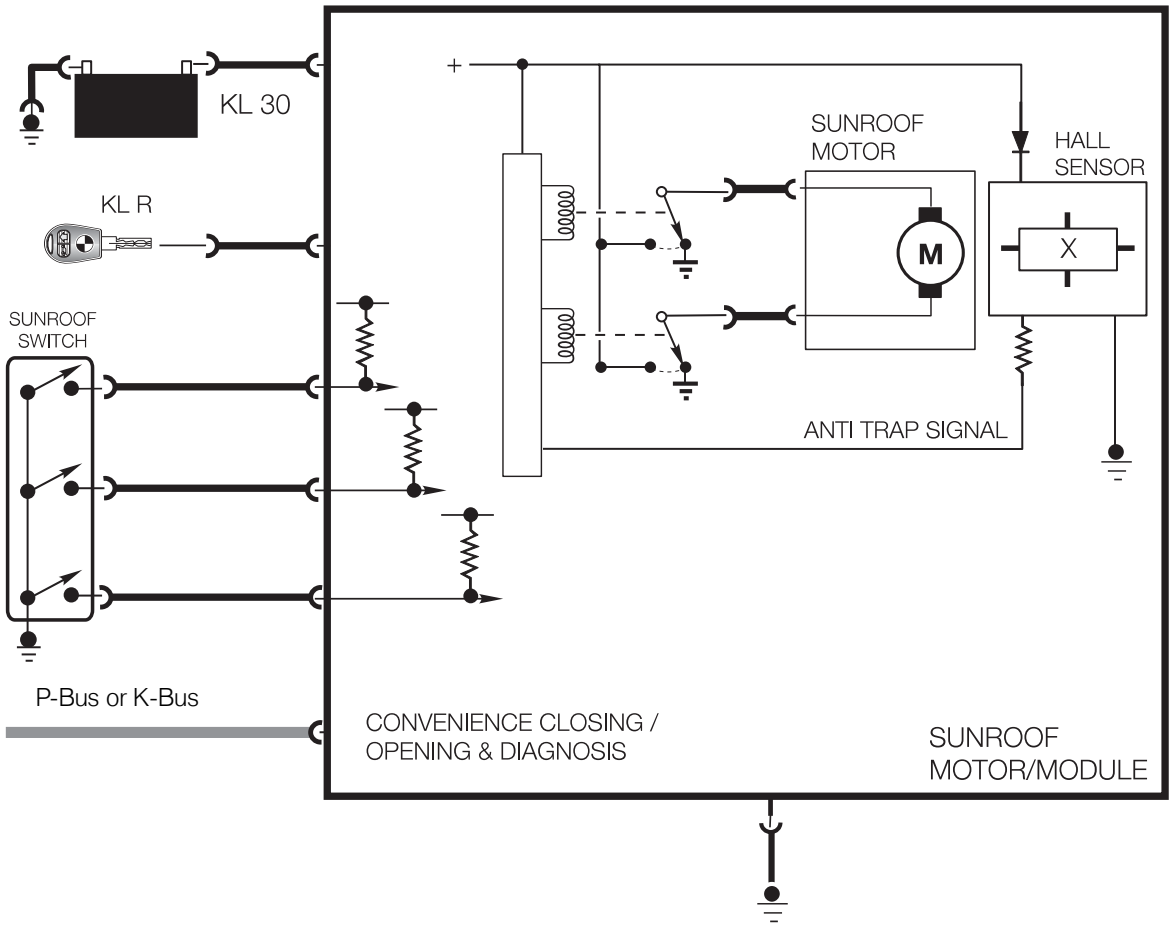
The motor is powered to open, close and lift the sunroof panel. The motor contains two hall effect sensors that monitor the motor shaft rotation providing sunroof panel position.



The hall sensors also provide the end limit cut out function for the SHD once the system is initialized. The SHD counts the pulses and cuts the motor out prior to the detected end run of the sunroof panel.

The combined motor module has a pin connector for interfacing the switch, and vehicle harness (power, ground and Bus.)

The electronic controls and relays are contained in the sunroof module (PM-SHD). The module is connected to the P-Bus (E38 >99 MY on the K-Bus) for comfort closing and opening as well as diagnosis/fault memory purposes.



Principle of Operation

Initialization

Initialization is required for the SHD to learn the end positions of the motor's travel. The hall sensors provide pulses for motor rotation, the SHD counts the pulses and determines where the panel is by memorizing the stored pulses.

If the system is not initialized, the sunroof will only operate in the tilt up and slide close positions. Initialize as follows:

- Press and hold the sunroof switch in either the tilt up or slide close positions for 15 seconds.
- The sunroof motor operates momentarily signifying initialization acceptance.

The SHD memorizes the pulses from the hall sensors on the next activation of the motor by driving the panel to its end run positions. The SHD senses an amperage increase and determines the end run position. The counted number of pulses is then used as the basis for calculating the panel position.

Updated SHD Module

A new, adaptive, sunroof drive motor was introduced in E46 production in 9/01. This new motor is available as a spare part under part number 67 61 6 918 977, which also fits the E38.

There is a revised initialization procedure for the adaptive motor described in the Repair Manual under Group 54. These procedures must be followed in order for the sunroof to function properly.

Procedure

After the new motor has been recoded in the normal manner, the procedure that must be used is as follows:

- Push the sunroof button in the up (tilt) direction and hold. After approximately 20 seconds the sunroof panel will make a small down-up movement.
- Release the button for no more than 5 seconds and push and hold it in the up (tilt) direction again.
- The roof will run through a full open and close cycle. Once this cycle is completed, the initialization and adaptation is complete.

Note: If the motor runs in the wrong direction when pushing the button in the up (tilt) direction, preventing proper initialization, get the sunroof to the closed position, and disconnect power to the motor for about 15 seconds. Reconnect the motor and start the initialization procedure again, and it should work properly.

Anti-Trap Feature: The anti-trap feature of the sunroof uses a hall sensor to detect obstructions while the sunroof is closing (pulse frequency slowed down) in the automatic close function. The anti-trap feature is shut down prior to full closing, about 4mm from full closed, to allow the sunroof to seat into the seal.

Note: The anti-trap feature is not functional when the switch is held in the manual close position.

Workshop Hints

SHD Self Diagnosis

The SHD monitors operation and stores fault codes if a defect is determined. The SHD monitors the following conditions:

- **SHD motor relays** - The relays are checked for sticking contacts (plausibility) and nonfunctional contacts.
- **Hall effect position sensors** - The SHD must detect a pulse frequency from the hall effect sensor(s) during operation.
- **Sunroof Switch** - The SHD monitors the signal plausibility of the coded signaling from the sunroof switch.

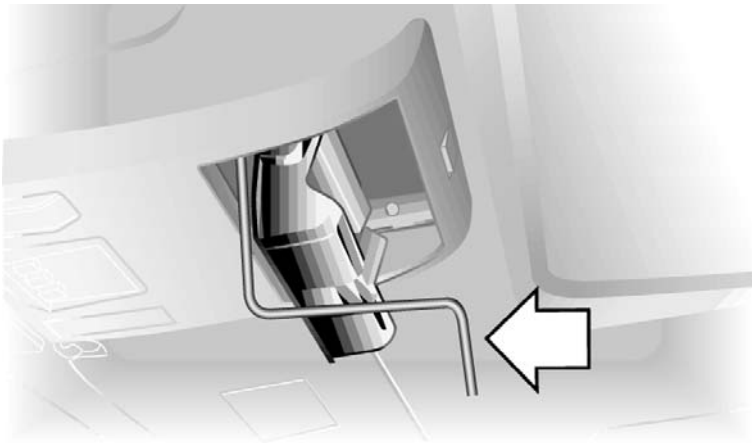
Sunroof Fault Response Characteristics

If a fault occurs with any of these functions, the SHD responds as follows:

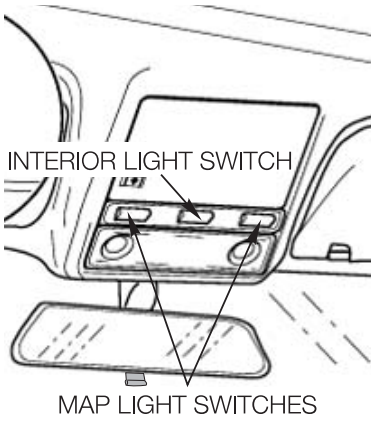
- Overrides the end run detection.
- Switches the motor off if the relay contacts stick for more than 500 ms.
- Switches the motor off if pulses are not received.

Emergency Operation of the Sunroof

If the sunroof motor does not respond to the switch signals, the hex key in the trunk lid tool kit is used to manually turn the motor shaft drive.



Interior Lighting



The GM controls the interior lighting automatically with the status change of several monitored inputs. The lighting can also be manually controlled using the interior light switch.

In addition to the various time controls, the interior lights are also subject to the 16 minute shut down of the GM (consumer protection).

Principle of Operation

The interior light switch is a push button switch that will carry out the opposite command of the current status of the lights. (ie: if the interior lights are currently on, pushing the button will switch the lights off.)

- If the interior lights are switched “ON” by the button with the ignition switched ON, the interior lights will remain on until they are switched off by the button.
- If the interior lights are switched “ON” when the ignition is switched OFF, the lights will remain on for 16 minutes (consumer cutout).
- Pressing the interior light button for longer than three seconds will switch the lights to continuous off. This feature is intended for workshop use. Pressing the button again will return the lights to the normal operational status.
- Locking the vehicle from the outside will immediately switch off the interior lights.

The ON/OFF conditions for the interior lights in the automatic mode are as follows:

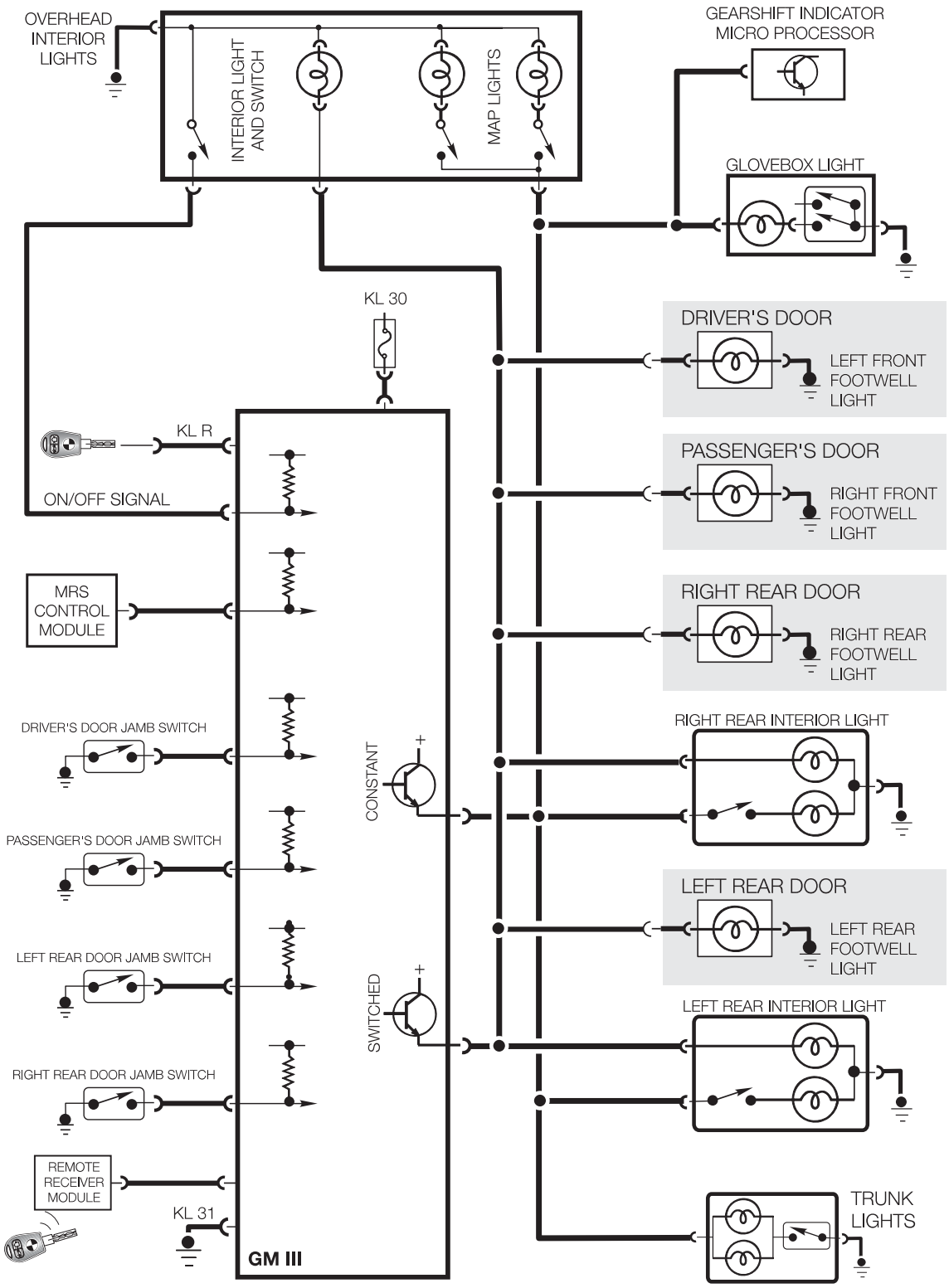
ON Conditions

- Door Open.
- Switching off ignition after exterior lights have been switched off.
- MRS Control Module crash input.
- Unlocking with FZV or pressing FZV lock button when the vehicle is already locked (interior search function).

OFF Conditions

- All doors closed with ignition on.
- All doors closed with ignition off after 20 seconds.
- 20 seconds after switching off ignition with lights off.
- 8 seconds after remote control activation.
- 16 minutes with door(s) open.
- When doors are locked.

Interior Lighting Overview (IPO)



System Components

Door Contacts

As mentioned in the Central Locking Section, the existing door contacts opened/closed are also an input for the interior lighting function. The E53 uses the Hall effect sensors for the purpose of monitoring door open/closed status (located directly behind the rotary latch plate encased in the actuator). The sensor is activated by the rotary latch plate's position.

- Door closed, the rotary latch plate is in the latched position. Current flow through the hall sensor is < 5 mA.
- Door open, the rotary latch plate is in the open position. Current flow through the hall sensor is > 12 mA.

A change in current flow informs the General module when a door is opened or closed.

Front Seat Interior/Map Light Unit

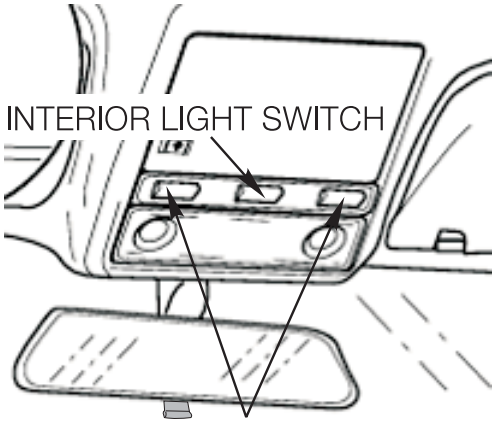
The overhead front seat interior light unit contains a single main interior light. The light is controlled by the GM automatically or by momentarily pressing interior light switch located on the light assembly.

The switch provides a momentary ground signal that the GM recognizes as a request to either turn the light on (if off) or turn the light off (if on).

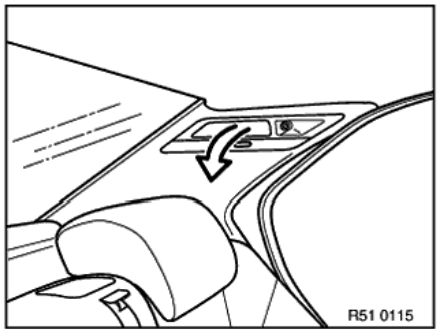
If the switch is held for more than 3 seconds, the GM interprets the continuous ground signal as a request to turn the interior light circuit off for the Workshop Mode.

The workshop mode is stored in memory and will not come back on even if the GM is removed from it's power supply and reconnected. The switch must be pressed to turn the lights back on.

There are two reading/map lights also located in the assembly. Each map light is mechanically controlled by depressing the corresponding on/off switch. The power supply for the map lights is supplied by the GM through the Consumer Cut Off circuit.



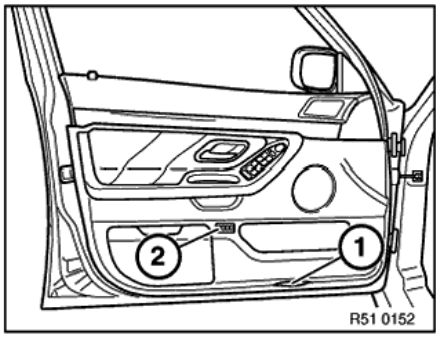
Rear Seat Interior/Reading Light Units
In each C pillar trim panel is an interior/reading light unit. These units each contain an interior light that is controlled with the front interior light and a mechanically switched reading light on the consumer cut off circuit.



Front Footwell Lights
In each front footwell, there is also a courtesy light. These lights are only operated when the GM provides power to the interior lighting circuit.

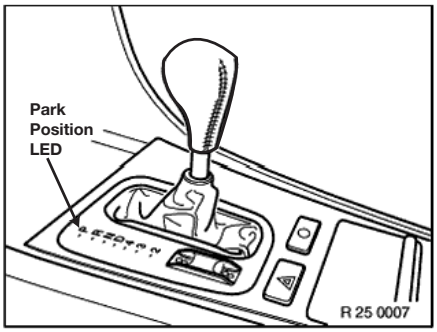
On E38 and E53 the doors also contain courtesy lights at the lower edge of the door panel (1).

Door Warning Lights (E38)
The additional “red” warning lights are installed in the edge of the doors (2). These lights are illuminated when the doors are opened.



Illuminated Transmission Shift Indicator
(E38): The E38 uses a microprocessor for displaying the shifter position in the center console. The processor receives shift position signals from a console mounted range switch. The processor illuminates the LED corresponding to the position of the range selector.

The park position LED will remain “on” after the ignition is switched off and stay on until the GM goes into the “sleep” mode.

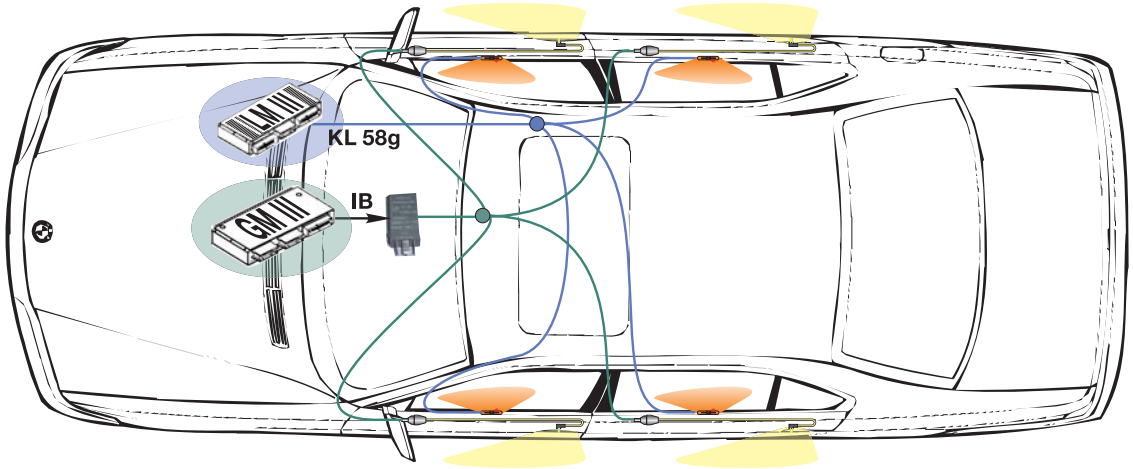


Soft Lighting Feature
The GM provides progressive voltage (up to 12v) providing the soft on feature to the interior lighting circuit when the interior lights are required. The GM gradually reduces the full 12 volt power supply providing soft off when interior light deactivation is required.

Visual Entry Aid (E38/E53)

The E38 (>99 MY) and E53 is equipped with the “Visual Entry Aid” lighting system which enhances operator convenience and safety. All interior door handles are supplemented with soft glow lighting for ease of locating the interior door handles. When activated, the exterior door lighting illuminates providing a subtle underglow for the exterior door handles on the E38 and exterior rear view mirrors on the E53.

- The interior door handle lighting (including later E53) is provided by slim profile LED’s and controlled directly by the LCM III.
- The exterior door handle lighting is provided by halogen bulb light sources in each door and fiber optic tubing. The light sources are controlled by a Visual Entry Aid Control Module which activates the lights simultaneously when the GM III activates the vehicle interior lights.

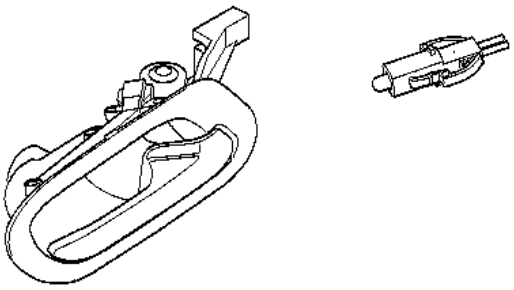


System Components

Interior Door Handle Lighting

The lighting is provided by orange glow light strips illuminated by LED’s.

- The light strips are part of the door handle shell and are not replaceable.
- The LED’s are individually replaceable.

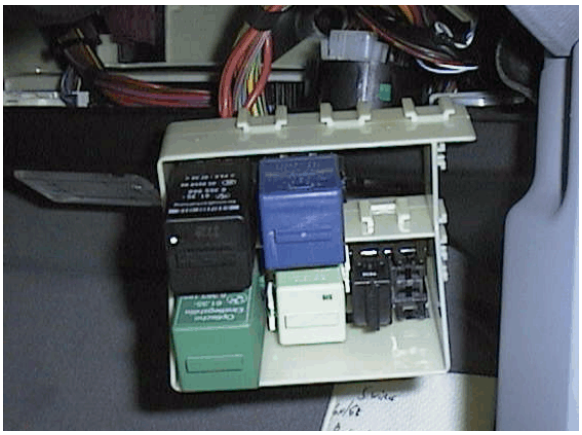


The LED’s are connected to the KL 58g interior panel lighting circuit. KL 58g is an output pulse width modulated control signal from the LCM III. The duty cycle changes when the LCM III detects a change in the voltage drop at the light dimmer input signal.

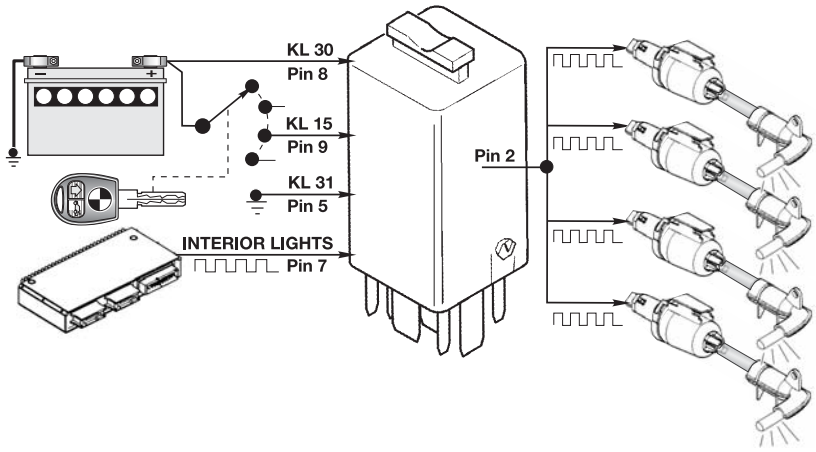
Exterior Door Handle Lighting

The Visual Entry Aid Control Module is located in the electrical carrier forward of the glovebox. To control the system, the Visual Entry Aid control module requires:

- KL 30
- KL 15
- KL 31
- Interior Light control signal (GM Output)



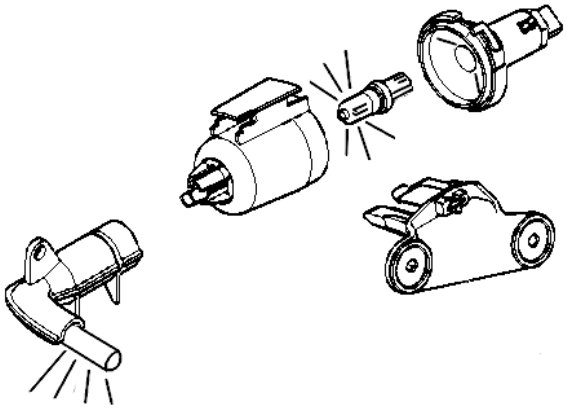
The GM controls the soft on/off feature of the vehicle interior lights by a pulse width modulated control signal. This signal is also an input to the Visual Entry Aid control module which requests simultaneously control (soft on/off) each exterior door light source.



Light Source Modules

Mounted in each door are the light source modules. The light source modules are made up of the housing, halogen bulb and reflector. The reflector holds the bulb and focus the bulbs light into the housing.

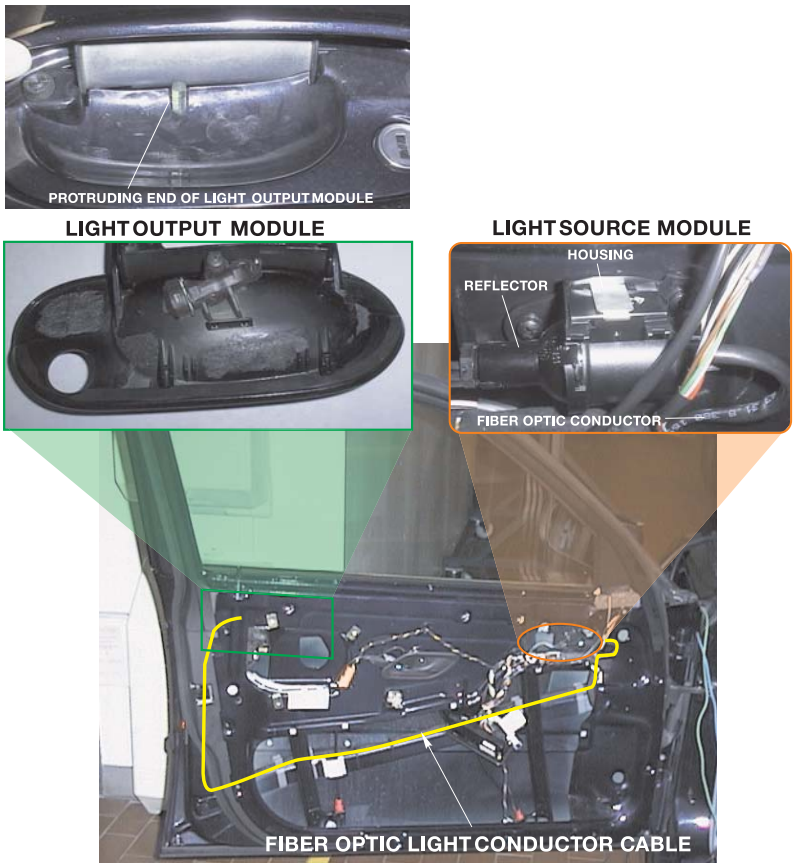
The bulbs are are available for individual replacement.



Fiber Optic Light Conductor Cable

The fiber optic cables carry the light to their respective light output modules at each exterior door handle.

Installation Note: The bending radius of the fiber optic cable should be less than 20mm when installing.



Light Output Modules

The exterior door handle frames have an additional mount to accept the light output module. The light output modules carry the light from the conductor cables to the exterior door handle recess as well as casting a soft exterior light on the outside floor area.

Principle of Operation

Lights ON: The exterior visual entry aid lighting is activated “on” when the vehicle interior lights are activated “on” automatically by the GM.

Lights OFF: Immediately after KL 15 recognition (immediate off - no soft off function). Soft off after a short delay once all doors are closed.

After a maximum of 20 seconds “on” time, the control module switches exterior visual entry aid lighting off regardless of interior light status.

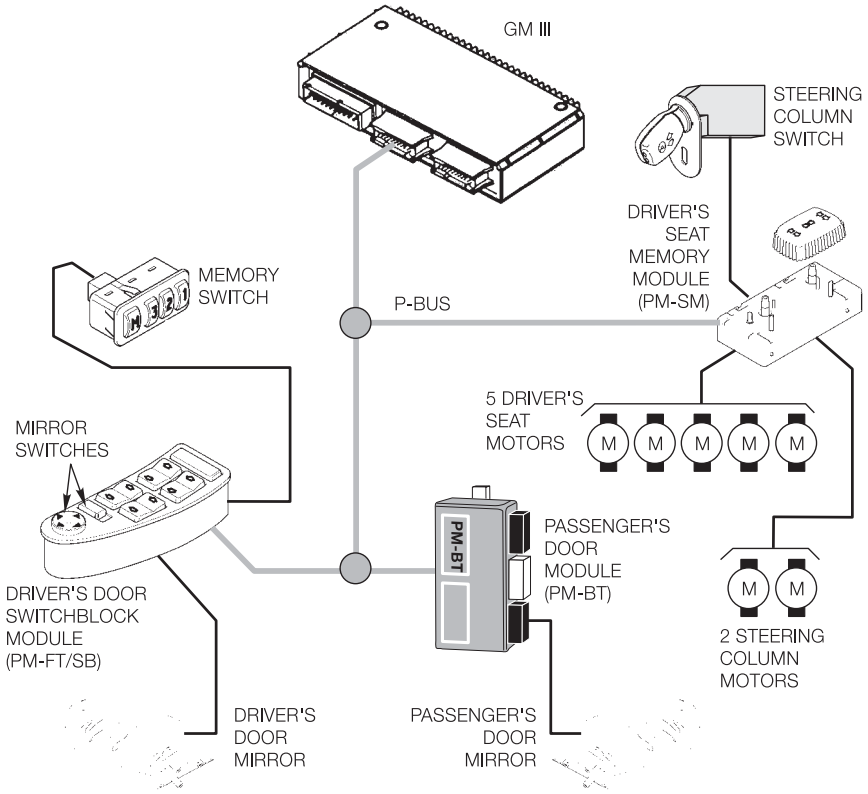
Seat/Mirror/Steering Column Memory

The front seats, outside rearview mirrors and steering column (if equipped) positions are electrically adjustable. The “customized” adjustment positions can be memorized and stored for three different users and recalled back to the individual positions (with the exception of the passenger seat - not in memory).

The basic features of seat/mirror/steering column operation, as well as the memory positions is integrated into the ZKE III system.

- Seat/Steering Column Memory Module (PM SM).
- Driver’s Door Switchblock Module (PM FT/SB - early E38 was separate).
- Passenger’s Door Module (PM/BT - E53 combined with window switch).
- General Module (GM III).
- 3 Position Memory Switch.
- Seat Switch.
- Steering Column Switch.
- Seat/Steering Column/Mirror Motors.

The Seat/Steering Column Memory Module communicates with the DISplus or GT-1 for diagnosis and Vehicle Memory encoding.

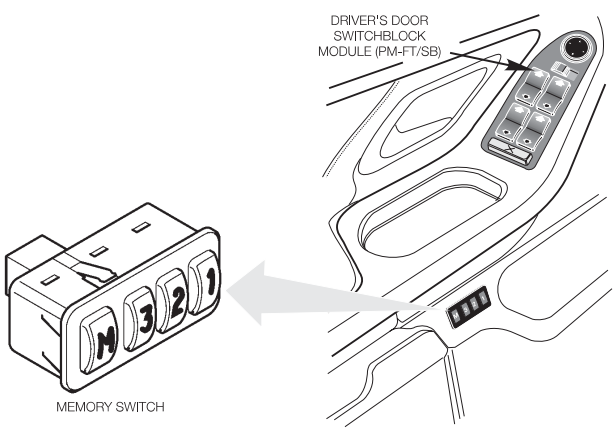


System Components

Manual Operation - The manual adjustments of the seat, mirrors and steering column are carried out with the respective switches as with the previous systems.

The mirror adjustment switch is located in the driver's switch block. The mirror operation input is a digital signal that is processed by each respective module for mirror positioning.

E38 Memory Switch



E53 Memory Switch

Memory Storage - The parameters for storing memory positions are are as follows:

- With the transmission range selector in "P" and the mirror change over switched to the left, switch the ignition on and press the "M" on the memory switch.
- The memory indicator lamp switches on for 7 seconds.
- Press one of the three position switches (1, 2 or 3) within the 7 second memory period.
- The current positions of the mirrors, seat and steering column are stored for recall.

The positions of the mirrors are stored in the respective door modules based on the position of the feedback potentiometers. The positions of the seat and steering column are stored in the seat module, based on the ripple count.

Recalling a memory position setting is possible by either pressing and holding the recall switch (1, 2 or 3) with KL 15 "ON" or tapping the recall button (1, 2 or 3) with:

- The driver's door open and KL 15 "OFF".
- KL R ON and KL 15 "OFF".

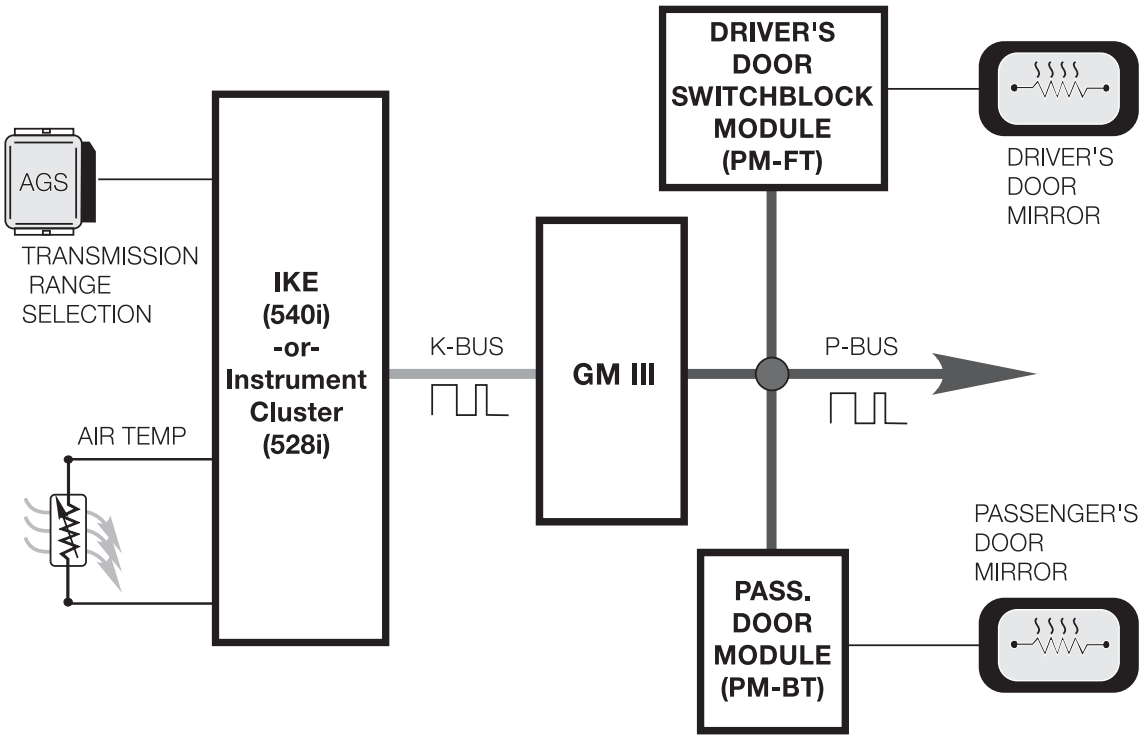
The recall movement can be interrupted at any time by touching any of the adjusting switches.

Mirror Operation

The output stages and memory storage of mirror positions is handled by the respective door modules. The positioning of the mirrors is signaled from the driver's door switch block/module. The signal passes over the P-Bus to the passenger's door module.

The memory/recall for the driver's mirror comes directly into the door module from the memory switch. The operation for the passenger's side mirror is carried out over the P-Bus from the driver's door module to the passenger's door module.

The memory positions are stored in each respective module. The memory position is recognized by the feedback potentiometers located on each mirror motor.



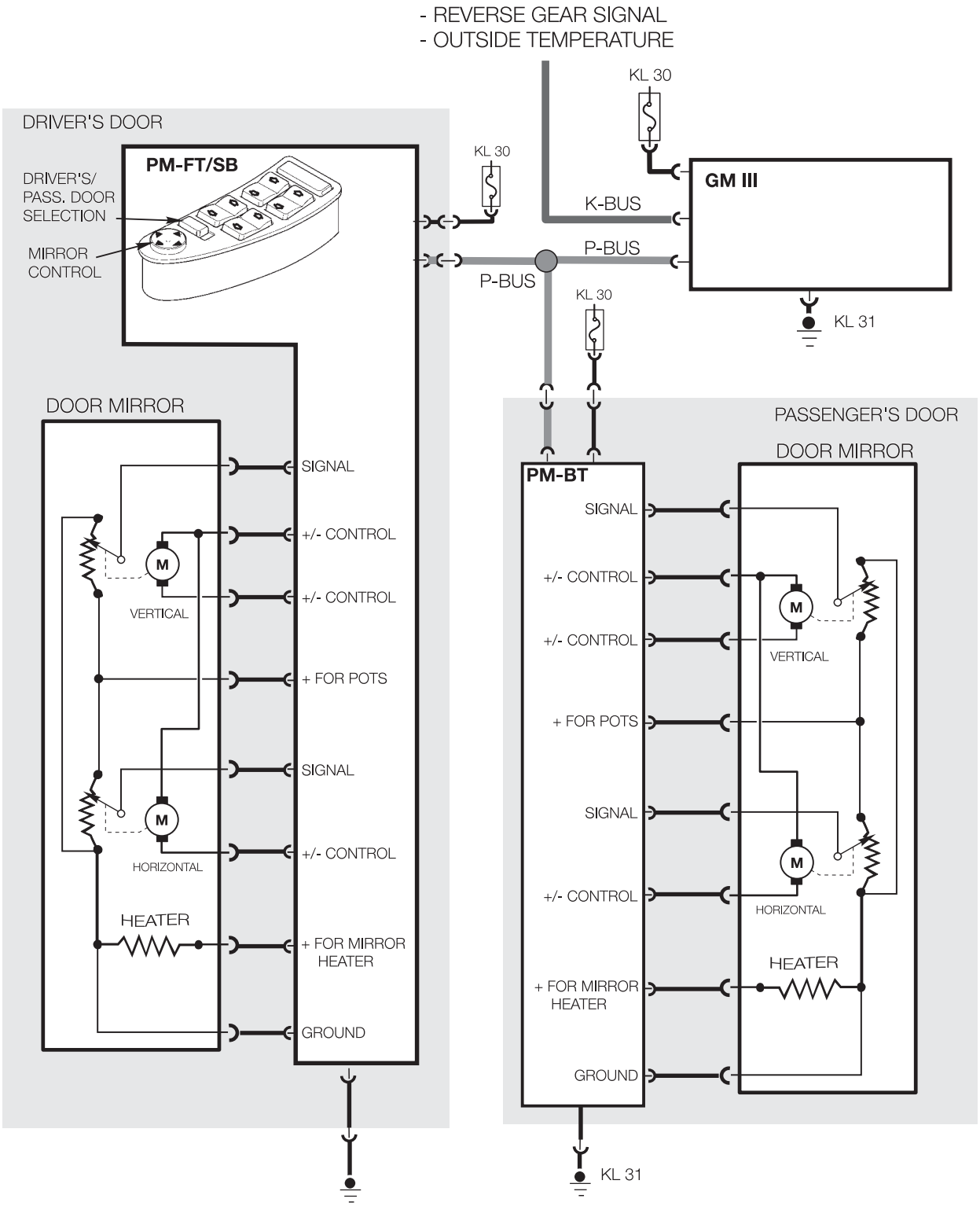
The reverse gear tilt feature for the passenger's mirror is signaled from the GM, over the P-Bus, when reverse is selected and the mirror switch is set for the driver's side.

Mirror heating is controlled by each respective door module. The GM receives the outside temperature from the IKE and passes it to the door modules. The "ON" time for mirror heating is adjusted based on the outside temperature.

A pulsed heating cycle is used for the mirrors based on the outside temperature.

Temperature	<-10°C	-10 to 0°C	0 to 15°C	15 to 25°C	>25°C
ON-Duration	100%	75%	50%	25%	5%

Mirror Overview (IPO)



Driver's Seat (E38/E39)

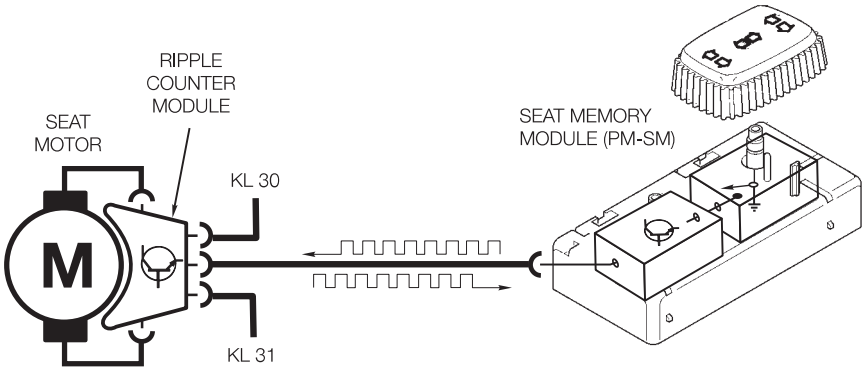
Each motor for seat adjustment contains a micro-processor (called a Ripple Counter) that receives a digital signal from the seat control module for motor activation. The motors are connected to KL 30 and KL 31 and respond to the signals generated by the seat module when seat movement is requested. The seat adjustment switch provides ground input signals to the module when seat movement is desired. The module processes these input signals and sends output signals to the seat motor processors. The seat motor processors activate the motors and the seat moves to the desired point.

The circuitry of the Ripple Counter detects the motor activation current. As the armature segments of the motor rotate passed the brushes, the current flow rises and falls producing a ripple effect. The peaks of these ripples are counted and stored in the Ripple Counter module. The memory function of the seat module uses this ripple count instead of feedback potentiometers to memorize and recall seat positions.

Ripple Count Recognition

When the seat is installed and the battery is connected, the ripple counter uses the initial position of the motors as the "Zero Position". Any movement from this point is counted as "+" or "-" pulses as the motors move in either direction.

The pulse position of the motors is stored in the seat module, in an EEPROM (of the PM-SM), before the ZKE goes into its "Sleep Mode".



This prevents the position recognition from being lost. If the battery is disconnected before the 16 minute sleep mode activation, the memory positions of the seat will be lost and reprogramming will be required.

Diagnosis

The PM-SM communicates with the DISplus or GT-1. The PM-SM monitors the seat motors and circuits as well as it's internal operation. Any detected faults are stored in the PM-SM fault memory and are called up when diagnosing the system with the Fault Symptom diagnostic plan. The PM-SM also provides status display to the DISplus of the input and output control signals as well as component activation.

Passenger's Seat (without memory)

The passenger seat control switch is purely a mechanical switching module that activates the passenger seat motors without position monitoring capabilities. Due to the limited operation requirements, the passenger seat control switch is not equipped with on board diagnostics.

The Passenger Seat control switch is equipped with an overload protection function. If excessive amperage is drawn due to a defective motor or a switch is stuck driving a motor to the end limit, the function activates opening the motor control circuit.

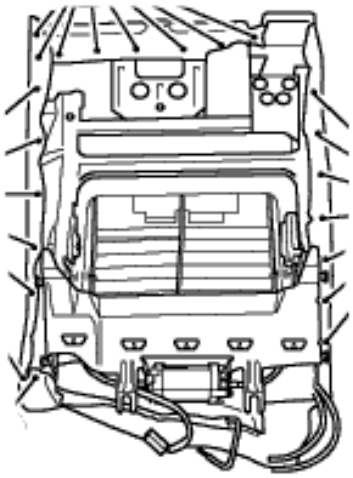
Passenger Seat Motors - Each motor is individually controlled by the Seat Control Switch. Each position motor is connected to the seat position switch by a two wire circuit providing motor activation in both directions (no position recognition).

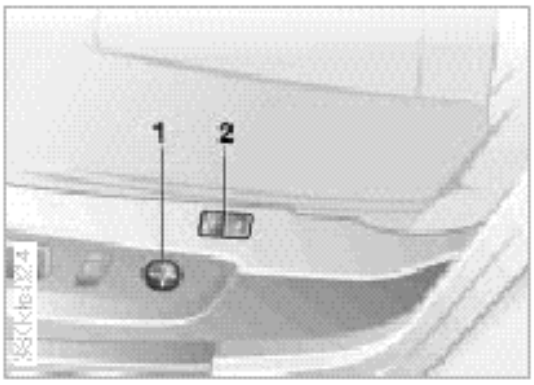
Passenger Seat Adjustment - Operation of the passenger seat is always possible regardless of the ignition key position. Moving a position switch operates a the motor control contacts directly, the switch applies voltage and ground path directly to operate the motor. Reversing the switch simply changes the motor polarity. More than one passenger seat motor can be run simultaneously.

Optional Seat Back Lumbar Support

The optional air bladder lumbar support system is similar in all vehicles (if equipped). Each seat contains the following components:

- Four position circular rocker switch in the seat base trim near the seat switches.
- Electrically controlled air compressor with over pressure cut out under each seat.
- Two solenoid activated air controlling valve blocks (one per air bladder). Each valve block includes an inlet and an outlet valve. When energized they direct air into the bladder(s) to inflate or relieve trapped air to deflate the bladders.
- Connecting hoses and air bladders in lower seat back.



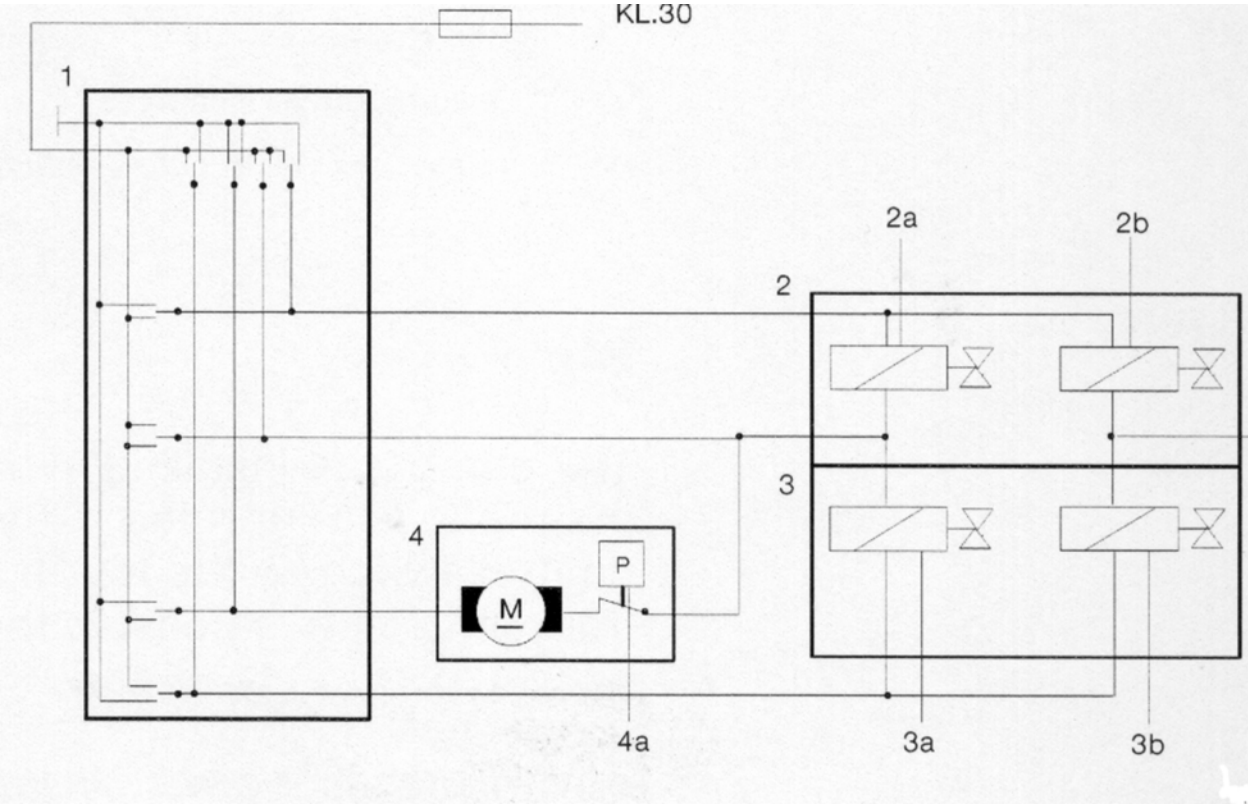


Principle of Operation

The lumbar support system can be operated at any time regardless of key position. The four position circular rocker switch provides power switching to operate the system as follows:

- Position 1: The internal switch contacts provide a power and ground path for both valve block inlet valves and the air compressor. Both bladders inflate until the switch is released. If the switch is held continuously, an overpressure bypass valve opens on the compressor preventing damage to the bladders.
- Position 2: Compressor activated, upper bladder inflates, lower bladder deflates.
- Position 3: Compressor activated, lower bladder inflates, upper bladder deflates.
- Position 4: Compressor is not activated. Upper and Lower bladders both deflate.

This function is not stored in memory for recall.

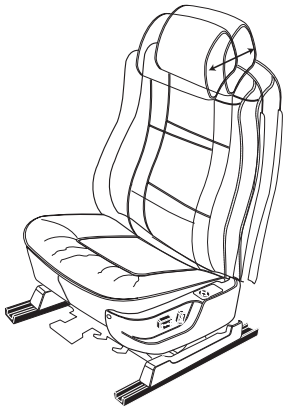


Diagnosis

The seat lumbar support system is purely electro-pneumatic control system. No electronic diagnostic communication is possible.

Comfort Seats (standard on E38 750iL, other models if equipped)

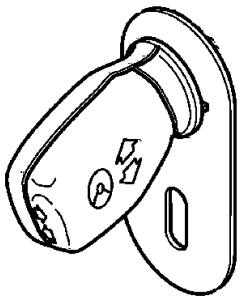
This option provides additional back support in the shoulder area. An additional adjustment in the upper backrest allows forward "contour" that is controlled by a rocker switch in the side panel.



When the ignition is on or off, the two way rocker switch can be pushed until the desired setting is achieved (forward/backward tilt). The motor drive operates the same as the seat motors.

The shoulder support adjustment is also stored in memory for recall.

Steering Column

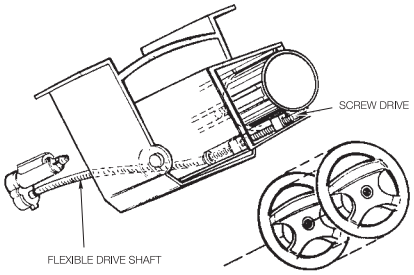


Principle of Operation

The electrically adjustable steering column used in the various models (if equipped) is similar in components, mechanical linkages and electrical operation.

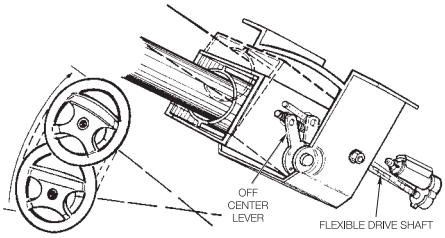
The steering column adjusting switch is mounted on the left side of the steering column and provides for four directions of column movement. The steering column switch inputs are processed by the seat module.

Motor Drives



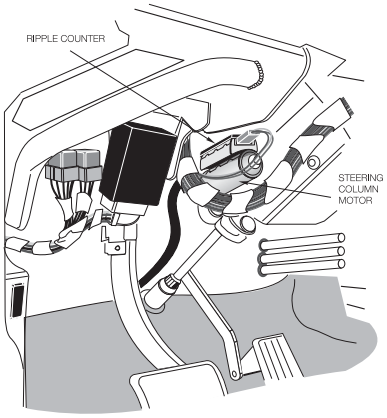
Forward/Back (Telescope) - A flexible drive shaft operates a screw drive which causes a forward/back movement of the steering column.

Up/Down - A flexible drive shaft moves an off center lever causing up/down steering movement.



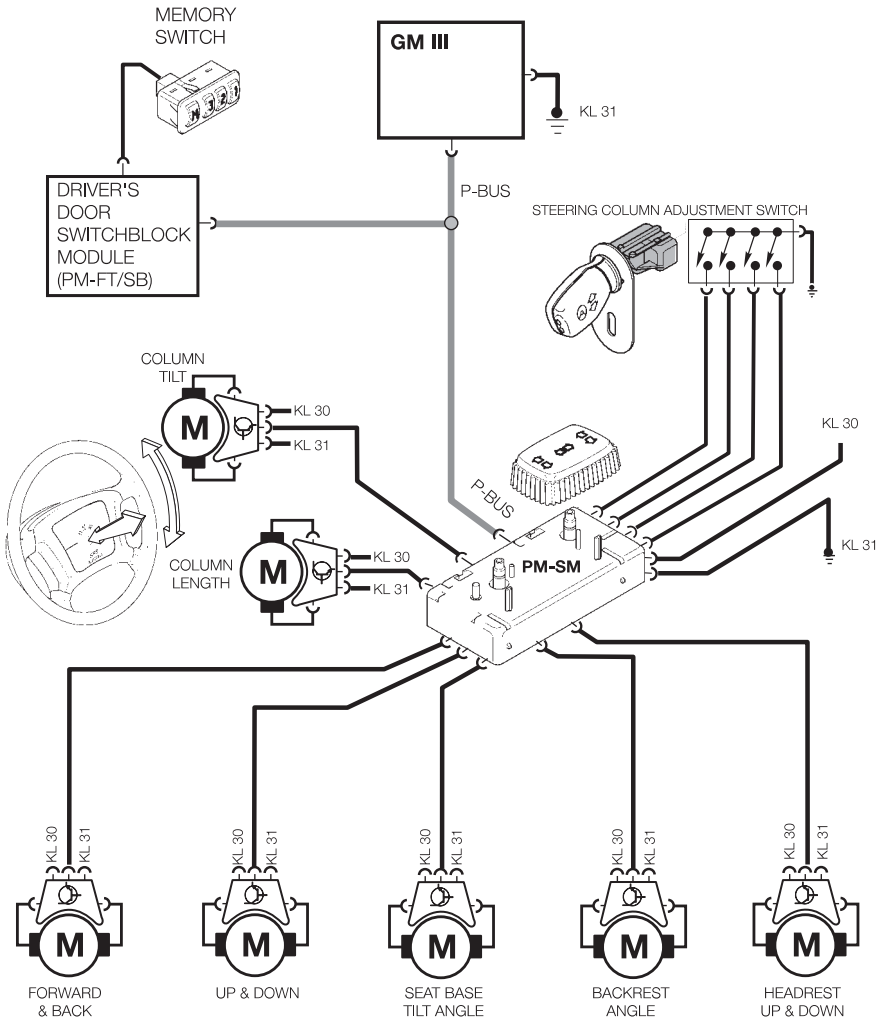
The motors for tilt and length also employ ripple counter modules for motor control and memory recall.

The control electronics for the steering column are integrated into the seat module.



The output signals are sent from the seat module to the steering column ripple counter modules for motor activation.

Steering Column Overview



Entry/Exit Aid

The Steering Column Memory provides the feature of raising the steering column to ease in exiting the vehicle and return it to the previous position after the vehicle is entered.

Raising the Steering Column

- The ignition is switched “off”.
- The ignition is switched to KL R
- The ignition is switched to KL15, driver’s door open with the handbrake applied

Lowering the Steering Column

- The ignition is switched to KL 15.
- The handbrake is released or the door is closed

The steering column recall movement can be interrupted at any time by tapping the adjusting lever.

Active Seat (E38 - if equipped)

Purpose of the System

Actively changing the surface of the seat helps to prevent muscle tension and fatigue particularly on long trips or sitting in one position for a long period of time. The seat causes weight transfers which are slight and imperceptible enhancing driving comfort. The basic seating position is not changed by this.

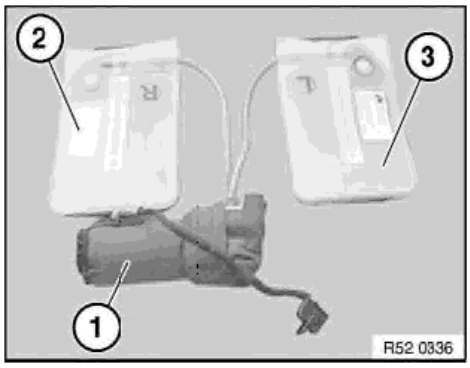
In the seat's upholstery beneath the surface of the seat is a cushion of fluid on the left and right. The fluid is slowly circulated back and forth between the cushions by a pump.

Principle of Operation

To activate this feature, the ignition must be in the KL R or KL 15 and press the switch which is located in the Center Console Switch Center (driver and/or passenger front seat).

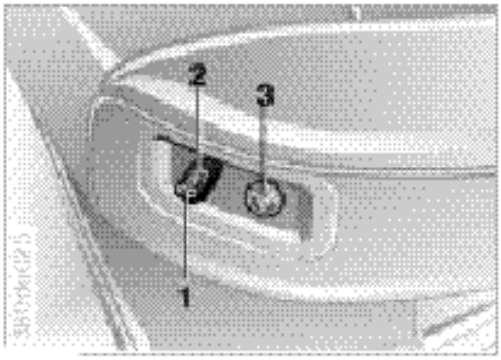
The switch provides a ground to the control module and an LED in the switch will illuminate. If there is a fault in the system the LED will not illuminate.

The control module, fluid bladders (2 and 3) and pump (1) is contained in each seat. The pump contains a Hall sensor to monitor the number motor revolutions and two pressure sensors to monitor each bladder for vacuum (indicating empty).



The fluid bladders (2 per seat) contain water glysantin mixture and are connected to the fluid pump. The fluid bladders are equal in volume at rest (15 mm. high) and will raise from 0 up 30 mm. when filled alternately from left to right.

Note: The pump unit and fluid bladders are replaced as a unit.



The control modules (one per seat) are connected to the P-Bus. The driver's side control module contains an acceleration sensor that monitors transverse acceleration of the vehicle.

Active Seat operation is temporarily interrupted during high acceleration.

Rear Power Seat (E38 750iL)

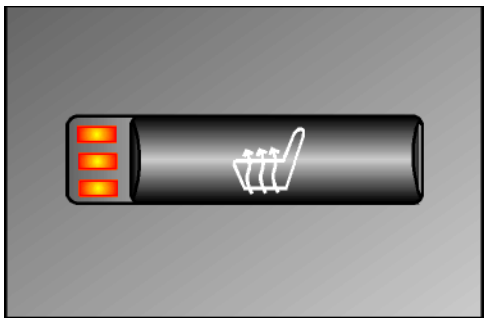
The rear seats in the 750iL provide electric adjustments for:

1. Backrest Angle - Control switch powers the motor.
2. Headrest Height - Control module behind each upper seat.
3. Lumbar Support

The headrest automatically extends when a passenger fastens the safety belt and will automatically retract when the safety belt is released. The power rear seat is a purely electric control system. No electronic diagnostic communication is possible.

Seat Heating Operation (from 99 MY)

Principle of Operation



The front seat heaters are adjustable through three ranges of heating output temperature.

Pressing the respective seat heater button once provides stage 1:

- All three LEDs illuminate and the heating elements are provided regulated output current producing a seat temperature of 111°F.

Pressing the button a second time provides stage 2:

- The top LED switches off and the heating elements are regulated to an output temperature of 102°F.

Pressing the button a third time provides stage 3.

- The top and middle LEDs are off and the heating elements are regulated to an output temperature of 95°F.

The SZM monitors the seat heating element temperature via an NTC feedback signal to regulate the output current which maintains the seat temperature.

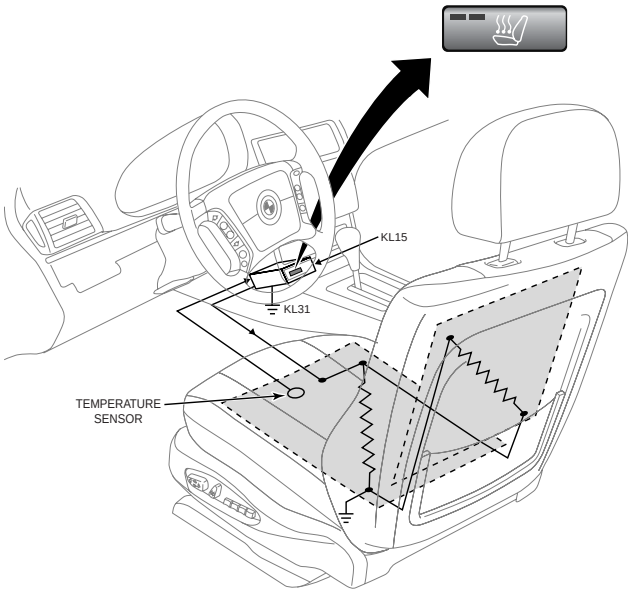
Seat heating is switched off by pressing the button a fourth time, pressing and holding the button for more than 1 second or when the ignition is switched off.

System Components

Carbon Fiber Heating Pads

In each seat is a two section heating pad wired in parallel. The heating pads are resistors which when powered produce radiant heat.

The seat base heating element also contains a temperature sensor for feedback to provide the temperature regulation output control.

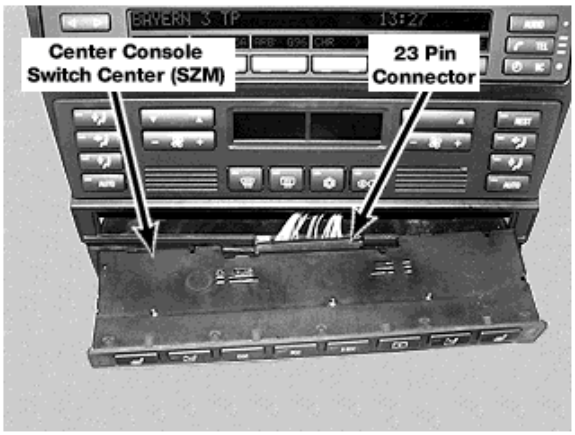


Center Console Switch Center (SZM)

From 1999 MY E38, E39 and E53 vehicles are equipped with a SZM to control the front seat heating and provide a diagnostic interface with the DISplus/GT-1 via the K BUS.

The SZM directly controls:

- Front Seat Heating
- Rear Window Roller Blind



SZM also provides a unitized switching center for:

- Park Distance Control (PDC)
- Dynamic Stability Control (DSC III)
- Electronic Damper Control (EDC).

The switch signal output for these systems is a direct output signal. All diagnosis functions are carried out through their respective control systems.

SZM Monitoring of Seat Heating

Battery Voltage - The SZM switches current supply to the heating elements off when battery voltage drops below 11.4 volts. However, the heating stage LEDs remain on. Regulated output current resumes when battery voltage raises above 12.2 volts for more than 5 seconds.

SZM Internal Temperature - The power output stages for the seat heating elements generate a considerable amount of heat when in stage 1 operation. The SZM monitors it's own internal temperatures and reduces the heating output when internal temperatures rise to a temperature of 185°F or switches it off completely above 203°F. As with battery voltage monitoring, the heating stage LEDs remain on when these temperatures are exceeded.

Fault Monitoring - The SZM monitors the temperature sensors and heating mats for faults. Detected faults are stored in the SZM. Fault Symptom Troubleshooting in conjunction with stored faults will initiate the diagnostic paths using the DISplus/GT-1. The following faults can be recognized:

- Shorts or opens in the wiring circuits.
- Shorts or opens in the temperature sensors.
- Open in heating element.

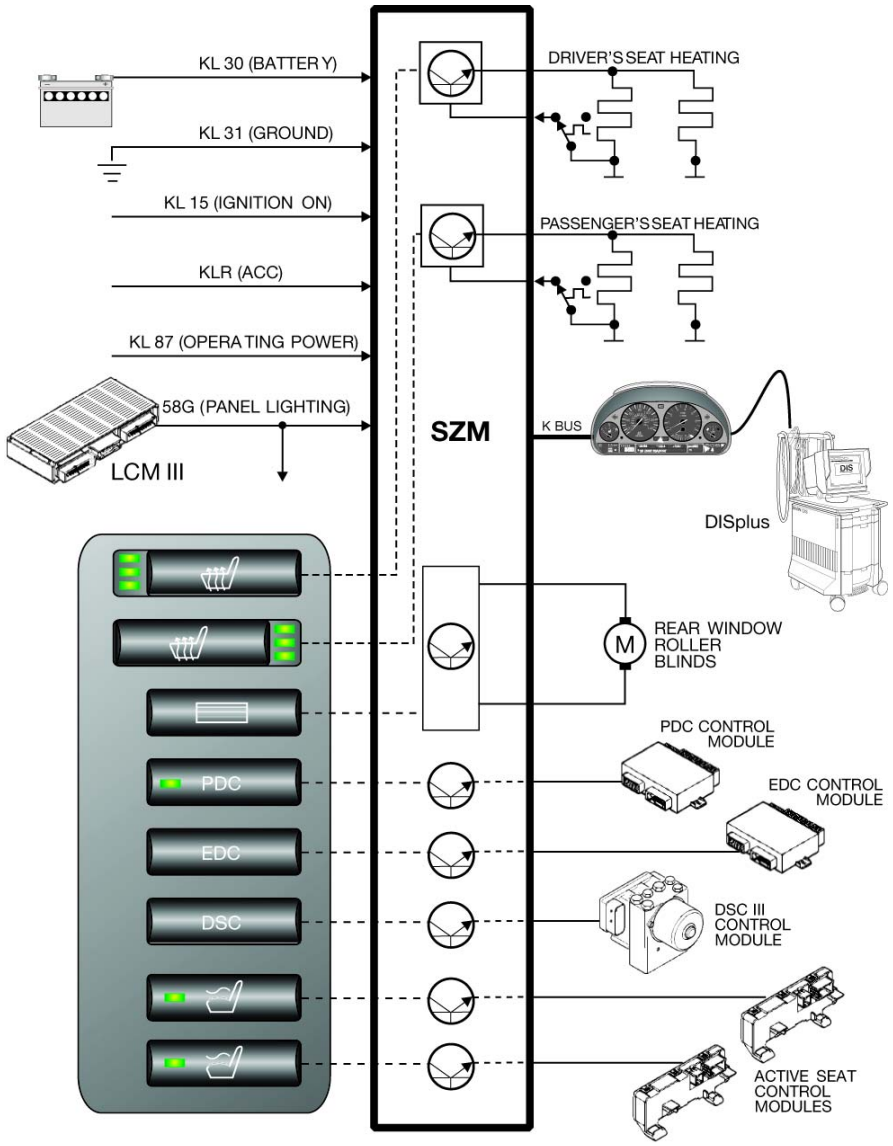
If a short is detected in the temperature sensor, the seat heating is switched off to prevent overheating. The Stage LEDs are also switched off with this fault present.

Rear Window Roller Sunblind Operation

The roller sunblind is activated by momentarily pressing and releasing (one touch) the sunblind rocker switch in the SZM. The SZM activates the motor in the appropriate direction. The SZM switches the motor off when the motor amperage increases indicating the blind has reached the end of its intended travel.

Fault Monitoring - The SZM continually monitors the motor drive amperage loads to determine jamming or blockages. If current values exceed preset values, the motor is switched off immediately.

Faults are stored in the SZM for opens or shorts in the motor or motor's wiring circuit. The SZM also provides diagnostic requests to monitor the switch input status via the DISplus/GT-1.



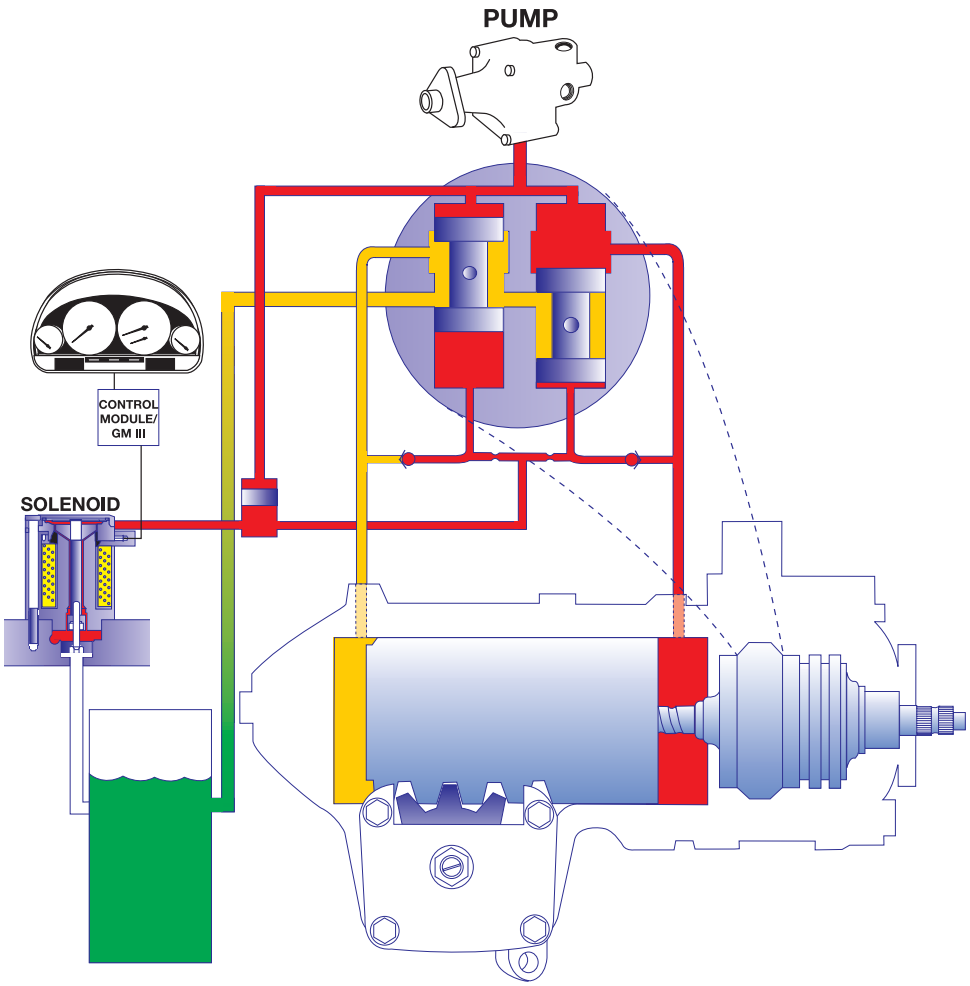
Servotronic (E38 only)

The servotronic steering system is based on a conventional power assisted steering system. An additional electro-hydraulic solenoid and oil passageways are added to the conventional worn and roller type steering box. The GM monitors the vehicle's road speed and regulates an electro-hydraulic solenoid. The servotronic steering system provides the following:

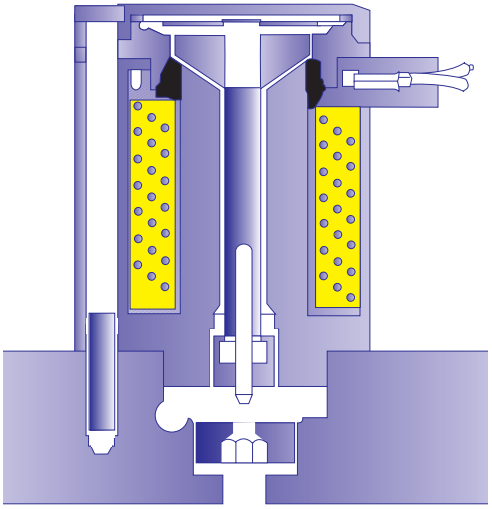
- A light steering effort at low speeds and while parking.
- Increased steering effort as road speed increases.

The "Direct Hydraulic Reaction" provided by the system allows the frictional forces between the front wheels and road surface to be transmitted to the driver. This allows the driver to make a better judgment in regard to the driving conditions.

This principle of direct hydraulic reaction can be used with the servotronic system because of the spool valves that are already used with the worm and roller steering box.



System Components



Electro-Hydraulic Solenoid

The solenoid regulates the amount of power steering assist for the servotronic system. It contains a needle valve that can restrict oil flow. When current is applied, the needle valve closes against spring pressure to restrict the oil flow.

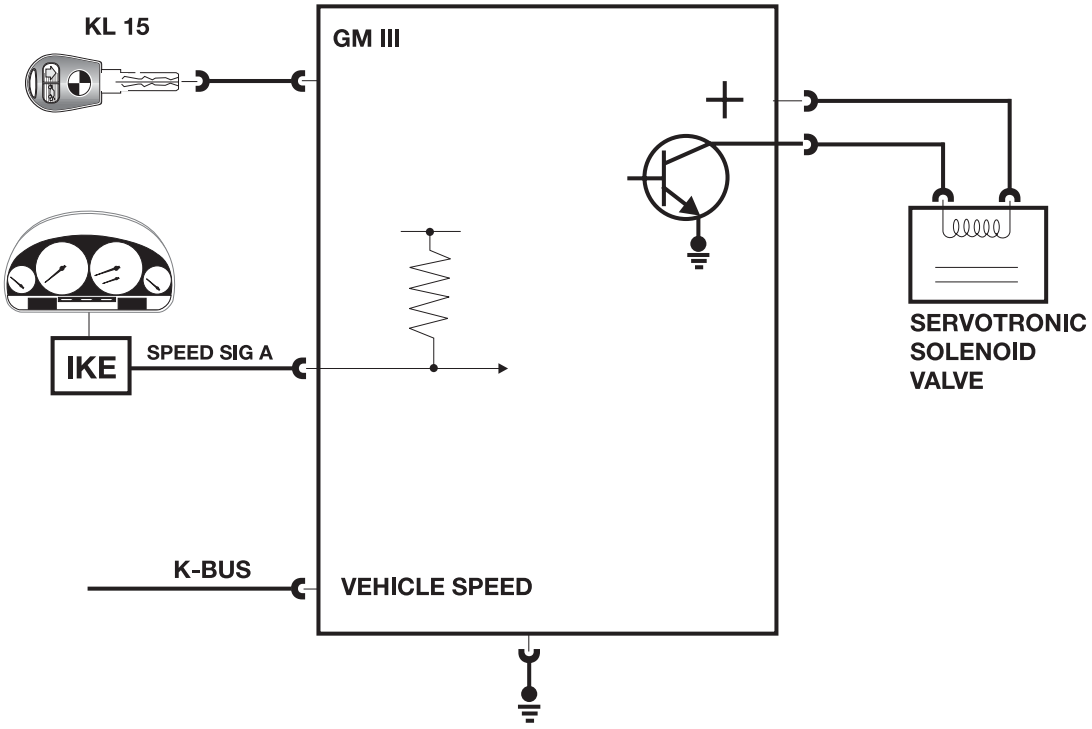
With maximum current applied, the valve is closed. This is the condition of the valve for slow speed driving and parking.

Without current applied, the needle valve is held open by spring pressure. This is the condition of the solenoid during higher driving speeds.

Electro-Hydraulic Solenoid Control

The GM monitors the road speed input and supplies the electro-hydraulic solenoid with power. The road speed signal "A" is supplied from the IKE (and K-Bus) on E38 vehicles and from the DSC Control Module on E39/E53 vehicles.

The solenoid is pulse width modulated for control and varies the amount of assist based on the road speed. The maximum assist is available while parking and driving at slow speeds.



Principle of Operation

Control logic (example E38) includes:

- Servotronic control electronics active with KL R being switched "ON" - ensure no delay in operation if engine is started and vehicle is immediately driven.
- Plausibility check for speed signal - the control electronics monitor both the Speed signal "A" from the IKE and the vehicle speed signal on the K-Bus.
- The ability to detect both acceleration and deceleration from the two speed signals - the speed signal from the IKE is updated every two seconds.
- The servotronic assist is reduced gradually when the vehicle is under acceleration.
- The servotronic assist is adopted to the lower direct reading during decel or braking.

Electric/electronic failures with the servotronic system will result in the following:

- Power/electronic failure of the control module or solenoid - steering assist the same as high speed driving (increased effort).
- Vehicle speed signal missing - control module retains the assist mode in effect when the speed signal was lost.
- Speed signal implausible - steering assist the same as high speed driving (increased effort).

The GM also provides the diagnostic “gateway” to the Servotronic status and “Component Activation” via the DISplus/GT-1.

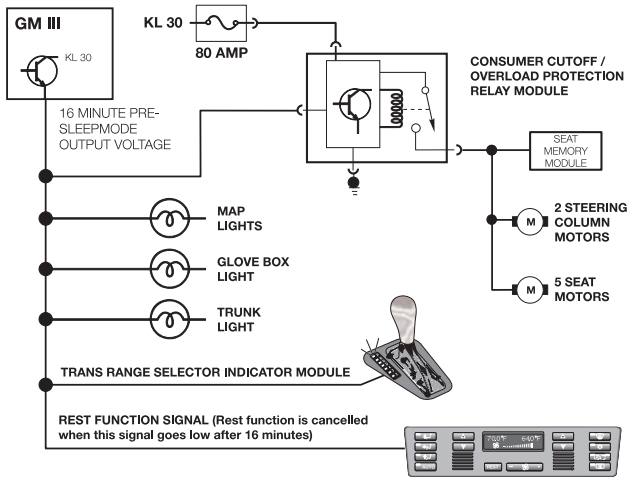
Consumer Cut Off

The Consumer Cut Off function interrupts battery voltage to circuits preventing inadvertent battery drain if one of these consumers were to remain activated. Circuits controlled by consumer cut off will be switched off as the GM enters into the sleep mode.

For example, the interior lights are connected to the consumer cut out circuit (KL 30) and can remain on if one of the control switches are left on. The consumer cut off will deactivate KL 30 to the interior lighting after 16 minutes (or with the DISplus/GT-1).

The following circuits are controlled by consumer cut off:

- Map/Reading Lights
- Glove Box/Luggage Compartment Lights
- Transmission Range Indicator Light
- Overload Protection Relay for
  - Power Seat Motors
  - Steering Column Motors



Overload Protection

The seat and steering column motors receive operating power through the consumer cutoff/overload protection relay module. The consumer cutoff signal from the GM signals the relay to maintain operating power to the consumers.

If the relay module detects an increase in amperage (overload) the relay will open. The relay module (K-72) is located in the electrical carrier behind the glove box. The relay is reset by switching the ignition “off” for 16 minutes, disconnecting the relay or the DISplus/ GT-1.

Sleep Mode

To lower the constant battery draw when the vehicle is parked, the complete ZKE system will go into the “Sleep Mode” 16 minutes after the ignition has been switched off and no further ZKE function is active.

For example, the approximate E39 (528i) Battery draw is:

- Ignition switch off = approximately 750 mA.
- One minute after = approximately. 560 mA.
- After 16 minutes (sleep mode) = approximately. 18 mA.

All modules in the ZKE system will go into the sleep mode. The P-Bus remains active, however no data transfer takes place until a wake-up request is received. The general module, door modules or keyless remote module can wake the system up and put the ZKE back on line. The K-Bus is active (high) in the sleep mode.

Sleep Mode Criteria: KL R, KL 15 OFF and no further function activated for 16 minutes.

Wake Up Criteria: KL R or 15 “ON” or a change in one of the signals listed below.

Signal	Activity	Originating Module
K-Bus	High	General Module
Door jamb switches (up to 4)	Low	General Module
Trunk lid lock cylinder microswitch	High	General Module
Trunk lid pushbutton microswitch	Low	General Module
Interior trunk lid pushbutton microswitch	Low	General Module
Central locking button	Low	General Module
Hood microswitch	Low	General Module
Trunk lid microswitch	Low	General Module
Interior light switch	Low	General Module
FIS Sensor (UIS)	Low	General Module
Tilt Alarm Sensor	Low	General Module
FBZV operational signal	High	FBZV Module
Driver’s door lock microswitch (lock)	High	PM-FT/SB
Driver’s door lock microswitch (unlock)	High	PM-FT/SB
Passenger door lock microswitch (lock)	High	PM-BT
Passenger door lock microswitch (unlock)	High	PM-BT

Battery Status

The GM monitors KL R on a dedicated circuit. If the ignition is switched on and detected via the KL R circuit but the GM does not receive KL R status via the K Bus, the GM monitors the KL R voltage level. If after an additional 0.3 seconds there is no K Bus activity, the GM initiates an emergency running program.

A substitute value for vehicle speed is used to allow the GM to operate certain functions.

The emergency running program will terminate if the GM detects a vehicle speed or KL R status via the K bus.

Diagnosis/Troubleshooting

The GM contains an EEPROM fault memory. Diagnosis and troubleshooting is carried out with the DISplus or GT-1. The diagnostic link is through the Instrument cluster over the K-Bus to the GM.

Workshop Exercise - Diagnosis

Using an instructor designated vehicle, diagnose the concern indicated by the instructor. Complete this worksheet using the proper "Complaint, Cause and Correction" format.

Vehicle: _____ Chassis #: _____ Production date: _____

Complaint:

Cause:

Correction:

Workshop Exercise - Diagnosis

Using an instructor designated vehicle, diagnose the concern indicated by the instructor. Complete this worksheet using the proper "Complaint, Cause and Correction" format.

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Correction:

Classroom Exercise - Review Questions

1. How does the GM III recognize the key position from the drivers door?

2. Describe the procedure used by the GM III to recognize an FZV key. Can the GM differentiate between different keys? How many can it recognize?

3. Why does the SHD (sunroof) module require initialization but the windows do not?

4. What type of sensor is used to detect the position of a seat with Memory? What type of signal does it produce?

5. How does the Seat Module communicate a request for a stored memory position with the mirror modules?

Classroom Exercise - Review Questions

6. What “convenience” features are available from the FZV key?

7. An customer driving an E38 complains that when exiting the vehicle the steering wheel moves up. What causes this concern?

8. How does the SZM monitor the Seat Heating temperature?

9. What circuits are controlled by Consumer Cut Off?

10. What functions will deactivate the exterior door handle lighting?